Railway
Mechanical Engineer

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Modern Refrigerator Repair Shop

Pacific Fruit Express Company Plant at Roseville, Cal., fully equipped and organized for efficient operation

THE original refrigerator car repair plant of the Pacific Fruit Express Company at Roseville, Cal., was placed in operation in 1910, but by 1927, it was outgrown and the entire plant had to be dismantled, largely on account of insufficient room for expansion of yard trackage facilities. A new plant was constructed two miles distant and operations resumed on a much more satisfactory and efficient basis. With the revised layout, more efficient shop equipment, a trained personnel, piece work, and a unit system of shop control, the annual production is in the neighborhood of 100,000 repaired cars, 25 per cent of which are given heavy or general repairs, or are rebuilt. The shop force with which this output is secured consists of a superintendent, general foreman and 10 department foremen who supervise a force which fluctuates considerably throughout the year, depending upon variations in volume of business, but averages approximately 360 men.

These shops and yards at the new Roseville plant are used exclusively for the rebuilding and repairing of refrigerator cars. They cover a wedge-shaped area of

Cars undergoing general and heavy repairs

Interior of the paint storage building showing the unit piling of barrels and the traveling crane equipment for handling them

about 110 acres, with a total track capacity for 1,129 cars as shown in one of the tables.

There are 17 miles of trackage in the plant and 46 switches with No. 9 frogs. The light repair yards have tracks of sufficient length to receive trains consisting of from 80 to 120 cars. The locomotive and caboose are cut off upon arrival in the yard, after which inspectors and crews start repair work. A switching locomotive is on duty, and during convenient periods cars in need of painting, rebuilding, wheel removals or general repairs are reclassified and set into the respective shop tracks, where such work is performed.

All work in the shops is organized on the progressive system. Starting at one end of the property the raw materials move towards the opposite ends where the finished car is delivered for service. In so far as possible, there are no interruptions in the flow of materials through the plant from its raw to its finished state. Also considerable efficiency is gained by the elimination of cross haul or change in direction of flow of materials.

Roseville shops were designed to carry on new and repair work simultaneously without having either of these work classifications interfere with the other. The plant is fully equipped to perform every operation incidental to the construction of new equipment.

Motor-Driven Machine Tools

The shop machine tools are all electrically operated with direct motor drive. Each tool is started and stopped by remote control with starter buttons mounted at the most convenient point on the machine.

The shop transportation equipment consists of 20 rubber-tired trailers, one Fordson tractor, two automobile trucks, one 25-ton steam locomotive crane and one steam locomotive.

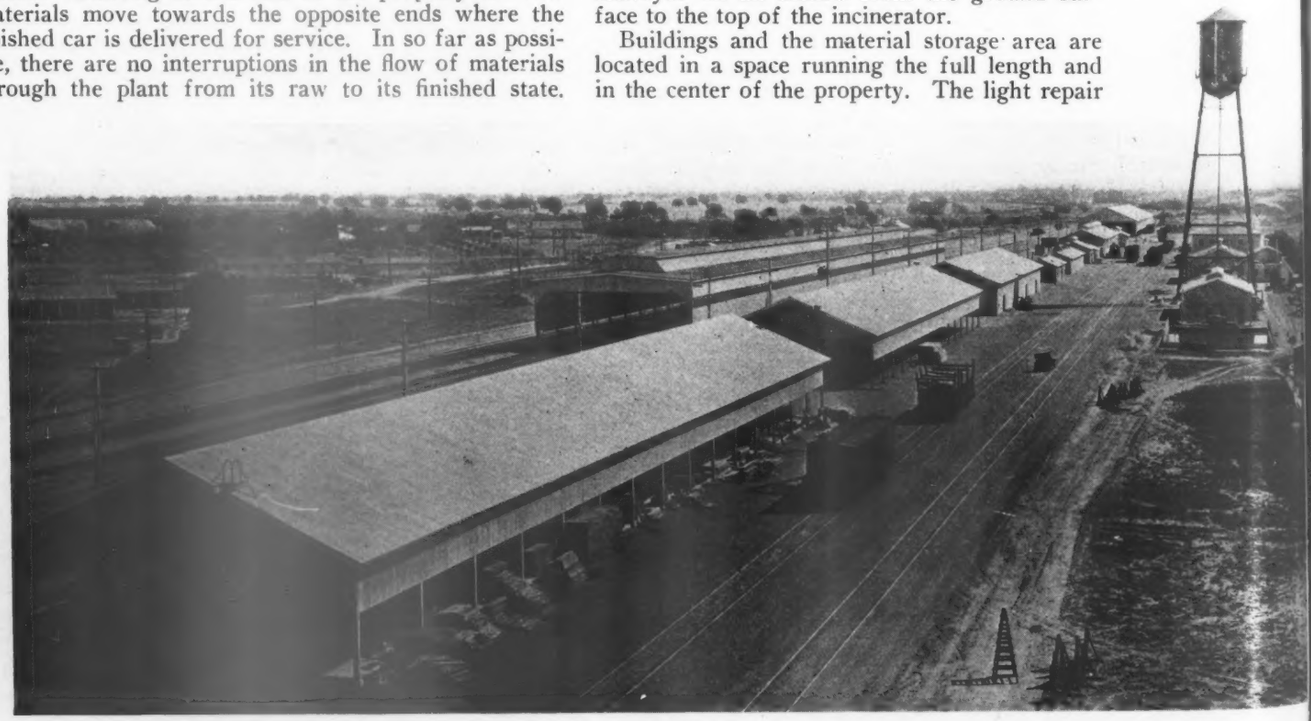
Water for car washing and general shop use is supplied from two wells, each equipped with vertical centrifugal pumps. The water is delivered into a steel tank with hemispherical bottom mounted on a tower. Water for fire protection is stored in a 150,000-gal. concrete reservoir.

Car Capacities of Various Units at Roseville Shops

	No. of tracks	Spacing on centers	Space allowed per car	No. of cars
Light repair tracks	7	20 ft.	45 ft.	723
Waste ice track	1		45 ft.	134
Heavy repair tracks	6	20 ft.	100 ft.	118
Rebuilt tracks	3	20 ft.	75 ft.	68
Paint tracks	4	20 ft.	55 ft.	65
Strip track	1	20 ft.	50 ft.	21
Total car capacity				1,129 cars

Two large incinerators are provided to dispose of waste material. One incinerator is located near the planing mill and connected by a pneumatic conveyor. The other incinerator is located near the strip track and wood reclaim mill and is equipped with a chain conveyor on an incline from the ground surface to the top of the incinerator.

Buildings and the material storage area are located in a space running the full length and in the center of the property. The light repair



General view of Roseville, Cal., shops of the Pacific

yards are located on one side of this space and the heavy repair and construction yards are located on the other side.

The plant is designed so that when constructing new equipment the work starts at one end of the property where trucks are assembled and the underframe is applied. From that point the car moves progressively in one direction and is completed at the opposite end of the property, fully painted, inspected and ready for use.

Purchase, Storing and Handling of Materials

Purchasing, storing and disbursing materials are handled by the purchasing and store department under the supervision of the purchasing agent, with general office located in San Francisco, Cal. A district storekeeper, reports to the purchasing agents in direct charge and has the required force to make requisitions, receive, store and disburse all material at his store, consisting of foremen, section storekeepers and helpers, material carriers and laborers.

Materials are stored in sectional arrangement at convenient points about the shops. The sectional arrangement follows a standard classification arrangement for accounting purposes. The material sections are logically grouped at Roseville district store in five divisions, each division under a section storekeeper who maintains necessary stock records to guide in maintaining a proper stock of materials on hand at all times to meet the requirements of the mechanical department. Stock records are maintained on standard American Railway Association stock-book forms. A master stock record, which is an exact duplicate of the stock record at the stores, is maintained in the purchasing agent's office. On regular assigned dates throughout each month, a complete inventory of all materials in each section is taken. A stock record, showing the quantity on hand, quantity to be ordered, quantity due on outstanding orders and monthly consumption of each item, is entered in the stock book. At the same time, a carbon record is made on a coupon sheet, after which the coupon for each sheet is detached and sent to the purchasing agent's office where it is pasted in the master stock book. This makes possible a complete monthly record in the purchasing agent's office of materials at each district store.

A well-lighted and orderly blacksmith shop

The standard unit piling is followed in storing of materials in each section, thereby permitting ready and accurate inventory at all times. The store department handles the delivery of all materials to the mechanical department, such delivery being performed by material carriers operating motorized equipment under the direction of the material delivery foreman. Motorized equipment in the store department service at the Roseville district store consists of two auto trucks, two Fordson tractors with 40 trailers and one gasoline Truc-lift with necessary platforms. Truc-lift, tractors and specially constructed rubber-tired trailers have been found to be most practicable for handling the delivery of materials. The trailers have a capacity of two tons with a 3-ft. by 9-ft. bed and are mounted on two 16-in. wheels in front and two 24-in. wheels in the rear. The top of the bed is 26 in. above the ground and arranged for stakes or side racks to be used when occasion requires. As rapidly as orders for materials are received, they are filled and delivered directly to the point of use.

As the activities of the mechanical and store departments are so closely allied, close co-operation is promoted at all times and the work progresses without delay.

The company provides a building and all equipment

Buildings and Structures at Roseville Shops

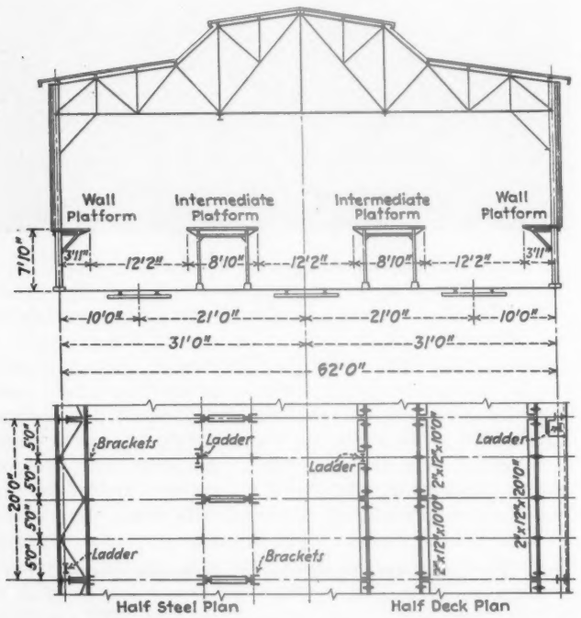
Car construction building	62 ft. by 600 ft.
Paint shop	80 ft. by 600 ft.
Blacksmith and machine shop	40 ft. by 221 ft.
Planing mill	50 ft. by 200 ft.
Dressed lumber building	50 ft. by 234 ft.
Milled lumber building	50 ft. by 250 ft.
Store and office building	50 ft. by 200 ft.
Paint storage and mixing building	30 ft. by 96 ft.
Reclaim mill for wood parts	30 ft. by 60 ft.
Welding shop	24 ft. by 36 ft.
Galvanizing shop	24 ft. by 36 ft.
Compressor room and pump building	30 ft. by 75 ft.
Wheel and axle shop	30 ft. by 50 ft.
Waste reclaim plant	20 ft. by 45 ft.
Oxygen building	18 ft. by 20 ft.
Toilet and locker room	20 ft. by 114 ft.
Kitchen and dining room	60 ft. by 84 ft.
Insulation storage building	50 ft. by 200 ft.
Yard office and emergency hospital	20 ft. by 63 ft.

Fruit Express Company

for a cafeteria. The management and the control of prices are handled by a committee elected by the employees. Food and kitchen work are furnished under contract with the committee. This arrangement has been used at the various shops of the company over a period of almost ten years with entire satisfaction.

Piece Work and Unit Shop Control

During the year 1928, the following cars were handled through Roseville shops: rebuilds, 595; general repairs, 384; heavy repairs, 1,224; light repairs, 87,197; foreign repairs, 8,438; total, 97,838. While by far a great majority of these cars received only light repairs, it will be noted that over 2,200 cars, or nearly 25 per



Wall and intermediate platforms in car reconstruction shop —Arrangement of hinged platform-extension aprons shown

cent, were given heavy repairs, general repairs or were rebuilt.

The shop personnel consists of the following: a superintendent, a general foreman, two assistant general foremen, rebuild foreman, light-repair foreman, blacksmith and machine-shop foreman, painter foreman, planing-mill foreman, welder foreman and scrap-reclaim foreman. The minimum and maximum number of workmen ranges from 241 to 478, depending upon the season of the year.

Approximately 45 per cent of the work at Roseville shops is on the piecework basis. Employees are in favor of the piece work system and there is always an abundance of applications on file for piecework positions. Once a man is employed on piecework it is difficult to make a transfer to the day basis, which is often required when certain branches of the work slack off and employees are transferred to other work not on the piecework basis.

Roseville shops, like the other shops of the Pacific Fruit Express Company at Colton, Cal., Los Angeles, Cal., and Nampa, Idaho, operates under the unit system of shop control. The unit system is predicated upon the principle that if the labor cost of one operation is $50 and another $100, there must be twice the labor involved in the latter case, and that a definite relation exists between the two operations in so far as labor costs are concerned.

The unit system has no relation to material or material cost whatsoever, being purely a labor system. While the system is not infallible, it serves as a splendid barometer in connection with shop operation and automatically regulates many practices which would never receive attention if such a system did not exist. It also serves as a basis by which the output of one shop or department can be measured against another.

Machine Tool Equipment at Roseville Shops

Wheel Shop
- 1—400-ton wheel press
- 1—Car wheel borer
- 1—Axle lathe

Planing Mill
- 1—10-in. moulder
- 1— 8-in. moulder
- 1—Cut-off saw
- 1—Band rip and resaw
- 1—Combination saw with boring and mortising attachment
- 1—Wood boring machine
- 1—Mortising machine
- 1—Tenoner and gainer
- 1—Band saw
- 1—Knife grinder
- 1—Saw sharpener

Machine Shop
- 1—Lathe
- 1—36-in. shaper
- 1—25-in. drill press
- 1—25-in. multiple spindle drill press
- 1—16-in. double end emery grinder
- 1— 6-in. power hack saw
- 1—Drill and reamer grinder

Blacksmith Shop
- 2—Electric pneumatic power hammers
- 2—Punching and shearing machines
- 1—Bulldozer
- 3—Forging furnaces
- 6—Blacksmiths' forges

Compressor Room
- 2—1200-ft. air compressors
- 2—Deep well pumps
- 1—Fire pump

Wood Reclaim Mill
- 1—Swing cut-off saw
- 1—Combination rip and cut-off saw

Metal Reclaim Shop
- 1—Double end punch and shears
- 2—Double head bolt cutters
- 1—Four-spindle nut tap

Tin Shop
- 1—Square shears
- 1—96-in. bending brake
- 1—Power slitting shears
- Set—Miscellaneous hand forming tools

Waste Reclaim Shop
- 1—10-hp. steam boiler
- 1—Centrifugal oil extractor
- 2—Oil extraction presses
- 1—Carding machine

The cafeteria and lunch room

The unit system readily indicates when shop forces should be increased or decreased and is a means of telling whether the organization is in balance with the amount of work on hand, or if the company is receiving a dollar's worth of work for each dollar paid in payroll. It also produces an incentive for foremen and others employing men to enlist the most ambitious and able workmen in the company's service, and prevents the employment of incompetents. When the slack season of the year arrives, requiring a reduction of forces, it protects the efficient workman. Superintendents, foremen and lead workmen are responsible for results; therefore, they are anxious to keep men in their forces who can produce results.

Interior view of car reconstruction shop showing elevated steel platforms and extension aprons

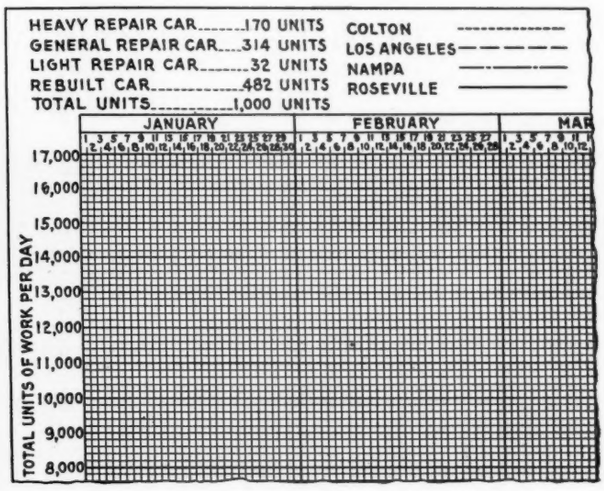
Prior to the adoption of this system by the Pacific Fruit Express Company, it was found that identical work varied in cost between the various shops. The system brought to light these differences and caused an analysis to be made which, in some instances, resulted in a change of method and reduction of cost, while in other instances the differences remained because it was justified.

This system has been in effect since 1926, ample opportunity being thus afforded to study its benefits. Superintendents, foremen and workmen favor the system and have co-operated wholeheartedly. They realize that the system is a means of making known their personal accomplishments and shop record, and this promotes friendly competition between the shops.

Unit System Involves Little Clerical Work

The unit system in use is simple and does not involve a large amount of clerical labor in its operation. The clerical work consists of the daily plotting of a shop chart for each superintendent and general foreman, showing the total shop production in work units, num-

(*Concluded on page 68*)



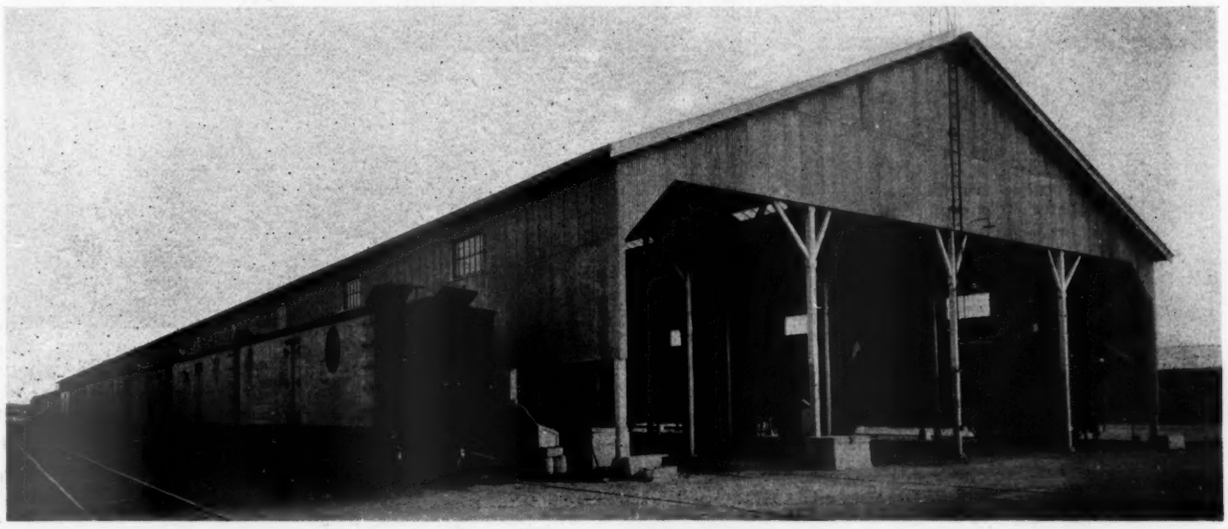
Form for recording the daily performance at four P. F. E. shops

Daily Unit Report from Shops to General Office

Roseville Shop, October 7, 1929

No. Cars		Units Each	Total
8	Heavy repair cars OK'd	170	1,360
4	General repair cars OK'd	314	1,256
235	Light repair cars OK'd	14	3,290
	Paint repair cars OK'd	50	
	Rebuild repair cars OK'd	482	
	Total No. Units		5,906
	Total Man-Days Worked	332	
	Average Units Per Man	17.79	

(Signed) Superintendent



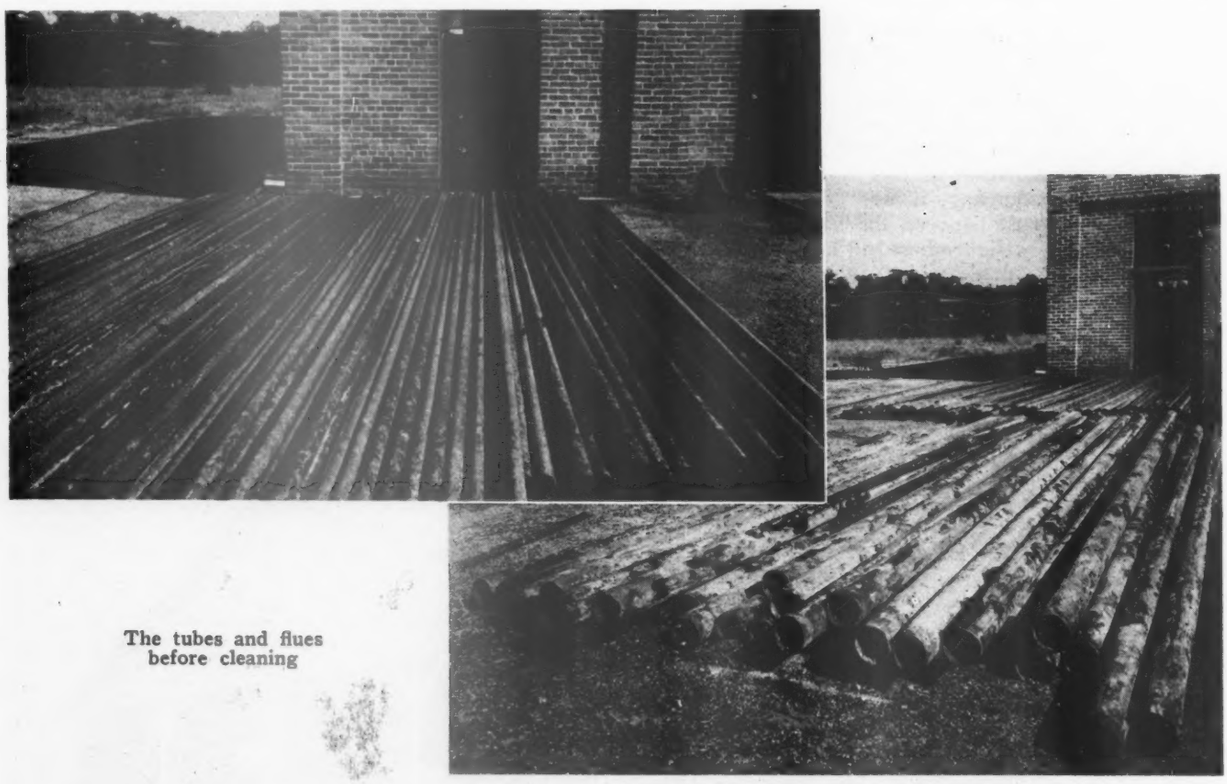
Exterior view of paint shop equipped with four through tracks and having a capacity of approximately 50 cars

Flue Mileage Record of the Florida East Coast

Total of 305,058 locomotive-miles made between settings on oil-burning 4-8-2 type in heavy passenger service

By F. S. Robbins
Superintendent Motive Power and Machinery, Florida East Coast, St. Augustine, Fla.

EARLY in 1925 the Florida East Coast purchased a number of Mountain 4-8-2 type locomotives from the American Locomotive Company, for passenger service, having a tractive force of 44,000 lb. and designed to burn oil. These locomotives are equipped with two Nicholson thermic syphons and Worthington feedwater heaters and are designed with 54-in. combustion chambers. They have a complete installation of Flannery hollow flexible staybolts. All of the radial stays are of the rigid type except four transverse rows on the front of the combustion chambers which are of the Flannery flexible type. In addition, each of these locomotives is equipped with a Type A superheater and has 181 2¼-in. tubes and 36 5½-in. flues, 22 ft. in length.



The tubes and flues before cleaning

Locomotive No. 432, one of the 4-8-2 types referred to, was placed in service in May, 1925. At the end of ten months service it had accumulated a flue mileage of 59,579 miles when it was necessary to renew the flues on account of a heavy scale formation and fire-cracked flue beads. This locomotive was again placed in general passenger service in April, 1926, and with the exception of two months—June and July, of 1928, when the locomotive was out of service to receive class repairs—has been in practically continuous service since that time.

In November, 1927, this locomotive was placed in service on the "Havana Special," trains 75 and 76, a heavy passenger train usually consisting of from 15 to 19 cars and with a 400-mile locomotive run. Locomo-

tive No. 432 hauled this train until October 9, 1929, when it was removed from service for class repairs. At that time it had an accumulated flue mileage of 305,058 miles.

The flues on the firebox end of the boiler were found to be in first-class condition with no fire cracks on the beads or welding. No work of any nature had been performed on the flues since they had been reset in March, 1926, until they were removed last October. The firebox sheets, stays and braces were practically free from scale. The illustrations showing the interior of the boiler after the flues were removed indicates a light scale formation, and also on the flues, tubes and front flue sheet. The total weight of all scale removed from the flues and boiler was approximately 2,500 lb. There was no indication of pitting. There was, however, after the flues were cleaned, a depreciation in weight due to internal wear from the use of sand in cleaning flues.

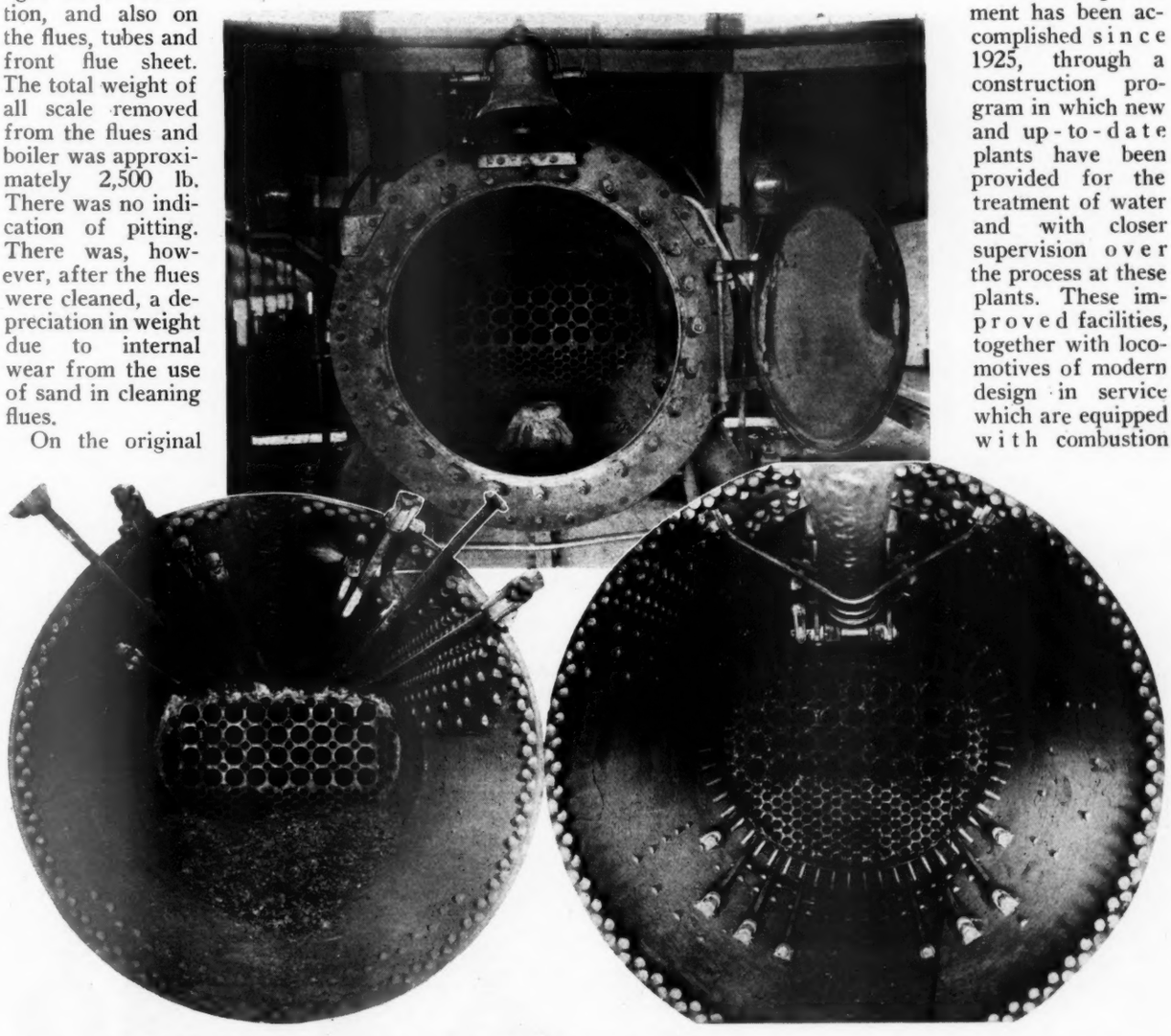
On the original setting of the flues, there was an accumulated mileage of 59,579 miles and on the last setting, 305,058 miles, making a total of 364,637 miles. The weights were as shown in Table I. Both the tubes and flues are of charcoal iron.

From the results shown in Table I, it is reasonable to assume that the tubes reset in the same locomotive will be good for approximately 350,000 miles additional service before reaching the condemning limit.

The feed water hardness analysis at New Smyrna, Fla., and Homestead, two of the principal stations where the locomotive was supplied with water since being assigned to the "Havana Special" in November, 1927, are shown in Table II. The fuel-oil consumption in gallons per car mile, between November, 1927, and October, 1929, is also shown in the same table.

The statement in Table II showing the water treatment for hardness at New Smyrna and Homestead is selected only to indicate what is accomplished by water treatment. Other treating plants where water was received en route by this locomotive were not considered in collecting the data in connection with the preparation of this article.

A real improvement has been accomplished since 1925, through a construction program in which new and up-to-date plants have been provided for the treatment of water and with closer supervision over the process at these plants. These improved facilities, together with locomotives of modern design in service which are equipped with combustion chambers, syphons and feedwater heaters, together with the installation of hot-water boiler wash systems at



Top: The smoke box after the tubes and superheater had been removed—Left: Inside the boiler looking toward the front flue sheet—Right: The rear flue sheet

Table I—Weight per Foot of the Tubes and Flues Installed on Florida East Coast Locomotive No. 432

	Weight per ft., lb.
2¼-in. tubes, new	2.9
2¼-in tubes, when cleaned	2.5
2¼-in. tubes, loss in weight	.4
5½-in. flues, new	9.5
5½-in. flues, when cleaned	8.0
5½-in. flues, loss in weight	1.5
Estimated condemning limit of weight, per ft. 2¼-in. tubes	2
Estimated condemning limit of weight, per ft. 5½-in. tubes	7

our enginehouses have produced results on this road.

Locomotives assigned to this long passenger run have a schedule for boiler wash after 2,400 miles. Only a few years ago, 60,000 miles was the maximum flue mileage and often it was necessary to renew the flues after 30,000 flue miles. Flues were removed on account of scale accumulation which, in turn, affected the fuel consumption. The front flue sheet of the boilers would become solid with scale and it was formerly considered economical to renew the flues and scale the boiler.

Boilers are Washed on a Mileage Basis

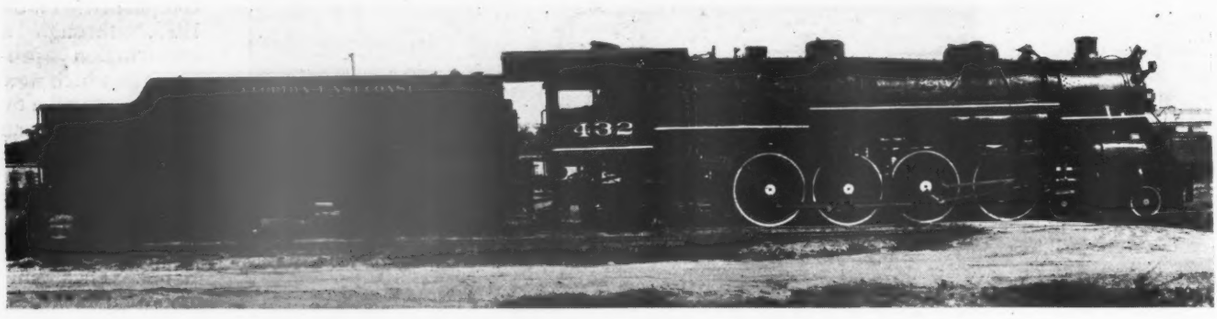
All locomotives are washed on a mileage basis, ranging from 2,000 to 2,400 locomotive miles. All washing and filling of boilers is done with hot water, the washing water at a temperature of 130 deg. F. and the filling water from 180 to 200 deg. F. After the boiler is drained and all plugs are removed at regular monthly inspection periods, the front part of the boiler is sprayed with Dearborn Chemical Company's formula No. 134. This compound is sprayed with an air jet in a fine mist against the flues, front flue sheet, braces and boiler shell. This is followed by washing the boiler and refilling as soon as possible after washing. This solution dissolves the carbonate scale which has formed from the use of treated water, and all other scale which has adhered to the carbonate scale is thrown off.

All locomotive boilers have two blowoff cocks, one located at the center of the throat sheet and the other on the boiler shell immediately back of the front flue sheet. At terminals, when the locomotive is taken from the enginehouse and before being coupled to the train, the locomotive is moved to some established place and the boiler is filled with water. When the water gage is full, the fire is cut out and the feed-water pumps or injectors are shut off. Two gages of water are then blown out, using the front and back blow-off cocks intermittently for a duration or not over ten seconds each. Injectors and feed-water pumps are not operated unless there is a bright fire in the firebox.

Enginemen are instructed to take advantage of blowing at station stops and water stations, where possible to do so, using the front and back blow-off cocks intermittently for a duration of not over ten seconds each. When boilers are blown at station stops or water stops, the injectors or water pumps must not be operated. It is desirable to blow the boilers when the locomotive is standing and this must be practiced where possible. Blow-off cocks should not be opened when starting or accelerating a train, or while the boiler is being worked at its maximum capacity.

The boiler washing method using the Dearborn chemical compound No. 134 has been in effect since June 1, 1927. This treatment of water and boiler blowing has reduced boiler foaming and delays from this source are now rare.

Attention is also called to the fuel performance data in Table II, which shows there was comparatively little increase in fuel consumption after the locomotive had reached this high mileage.



Locomotive on which the flue-mileage tests were made

Table II—Consumption of Fuel Oil for 21 Months and Hardness Analysis of the Boiler Feed Water Used in Locomotive No. 432

Month	Fuel oil: Gal. of fuel per car mile	Hardness analysis of feed water: New Smyrna Raw	New Smyrna Treated	Homestead Raw	Homestead Treated
November, 1927	.89	H 20.4	H 3.6	H 11.6	H 2.1
December	.68	20.0	4.6	11.4	2.2
January, 1928	.57	18.8	4.7	11.4	3.4
February	.54	19.8	3.0	11.8	1.9
March	.56	19.3	2.7	11.5	1.8
April	.55	19.8	1.9	11.5	1.8
May	.55	18.9	1.7	11.2	1.7
August	.56	20.8	1.7	12.3	3.1
September	.59	16.9	2.4	9.0	2.5
October	.57	20.8	1.9	11.6	2.1
November	.62	20.2	2.1	9.5	2.0
December	.55	20.1	1.8	10.3	2.0
January, 1929	.62	20.4	1.6	10.7	2.1
February	.70	20.2	1.5	11.4	1.9
March	.55	20.7	1.8	11.5	2.1
April	.57	20.7	1.5	11.5	2.1
May	.57	20.2	1.9	11.6	2.0
June	.58	19.9	2.7	11.2	2.1
July	.58	20.4	1.9	11.3	2.0
August	.57	20.0	1.9	11.6	1.9
September	.59	20.5	1.7	11.4	1.7

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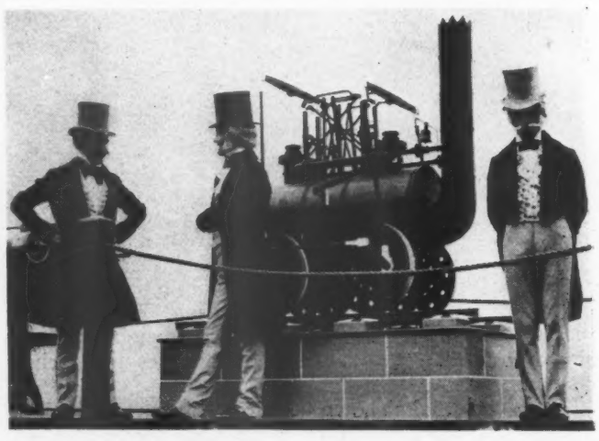


Wide World Photo

Tableaux shown in connection with the centenary celebration of the Rainhill trails on the Liverpool & Manchester—George Stephenson explaining the mechanism of the "Rocket"

C. M. St. P. & P. Mallet locomotive "simpled" at Milwaukee shops

Milwaukee Mallets Converted

Compound cylinders replaced by 21½-in. single-expansion cylinders—Simplified steam pipe arrangement developed

IN 1910 and 1911, the Chicago, Milwaukee, St. Paul & Pacific received 25 Mallet locomotives for handling freight service over the 2.2 per cent grades on the Lines West, but after these sections were electrified, something of a problem was presented to find a satisfactory assignment for this class of power. The locomotives were used at hump yards and for service on the main line on the Idaho division between Avery, Idaho, and Othello, Wash., the 220 miles of steam operation between the two electrified zones. It developed, however, that the electric locomotives were able to haul a greater tonnage into either Othello or Avery than the Mallets could handle between these points, thereby necessitating reductions in full tonnage trains over the Idaho division. The possibility of increasing the output of the Mallet locomotives by simpling them was, therefore, studied and a design developed.

One of the first determinations was to ascertain the tractive force necessary on the ruling grade of .4 per cent to handle 5,000 tons, which was found to be 67,000 lb. at 15 m.p.h., necessitating a starting tractive force of 82,720 lb. With 57-in. drivers, 30-in. stroke and 200-lb. boiler pressure, four 21½-in. cylinders would develop this power and still obtain a factor of adhesion of 3.91.

The saturated engine operating as a compound was about 20 per cent more economical in the use of steam than a single-expansion engine, so that consideration to overcome this feature in the boiler design had to be given. Study developed that in order to obtain the required evaporation, more heating surface was necessary and it was supplied by the addition of Thermic syphons, two located in the firebox and two in the combustion chamber. This added 105.5 sq. ft. of heating surface and about 5,800 lb. of steam per hr. to the boiler capacity.

The addition of a Type A superheater and a Coffin feedwater heater increased the capacity of the boiler and effected a saving in fuel and water as well. The boiler rating was increased to 102 per cent and the calculated evaporation to 61,450 lb. of water per hour.

The original 23½-in. high-pressure cylinders were bushed to 21½ in., making use of the same valves and machinery with slight alterations in the valve motion, consisting of the use of a self-centering steam-chest head and changing the radius of the link to suit.

The low-pressure cylinders were discarded and new cylinders designed for single-rail frames with attachment flanges for live- and exhaust-steam branch pipes. On the first locomotive converted the old frames, from a point approximately 15 in. back of the front drivers, were utilized, casting new forward sections and welding them to the rear sections of the front frames. A substantial design of front foot plate, extending back under the cylinders, provided a rigid bracing for frames and cylinders, the latter being attached to them.

The valve motion on the front unit was redesigned to provide for the inside admission valve and to synchron-

ize with the motion on the rear engine at the various settings of the reverse lever, so as to provide an even distribution of power between the two units.

An Alco type of power reverse gear was used, loop type of spring hangers, automatic cylinder cocks, Whelan by-pass and drifting valves, a 3-in. Hancock boiler check on left side, and two Detroit 24-pint, six-feed force-feed lubricators. The locomotive was equipped with the standard Milwaukee arrangement of oil-burning apparatus.

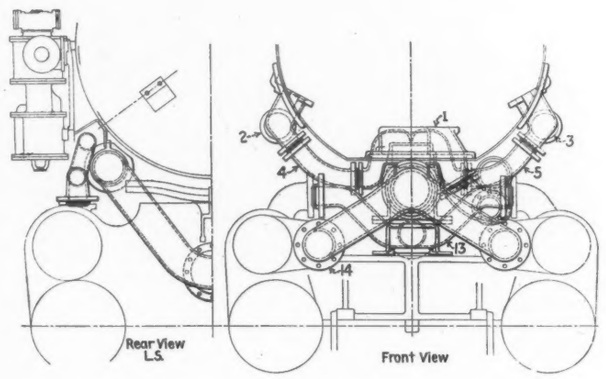
Steam Piping Arrangement Simplified

An entirely new arrangement of steam and exhaust piping was necessary, the objective being to provide as few joints and moving parts as possible, and locate these near the center line of the locomotive, thus reducing the movement of ball joints when curving. The forward end of the front of engine has a lateral movement of approximately 15 in. either side of the center line at the cylinders when traversing a 20-deg. curve.

Referring to the steam-pipe drawing, the general arrangement will be evident. The live steam passes through the throttle and superheater header in the usual manner, and from the header into the customary steam pipes to divided castings *2* and *3* at the base of the steam pipes. These castings divide the steam equally, that for the front cylinders going through cast-iron pipes *4* and *5*, and that for the back cylinders through seamless steel pipes *6* and *7* to the steam chests of the back cylinders. Slip joints *8* and *9* are provided in the forward end of each of the pipes *6* and *7*.

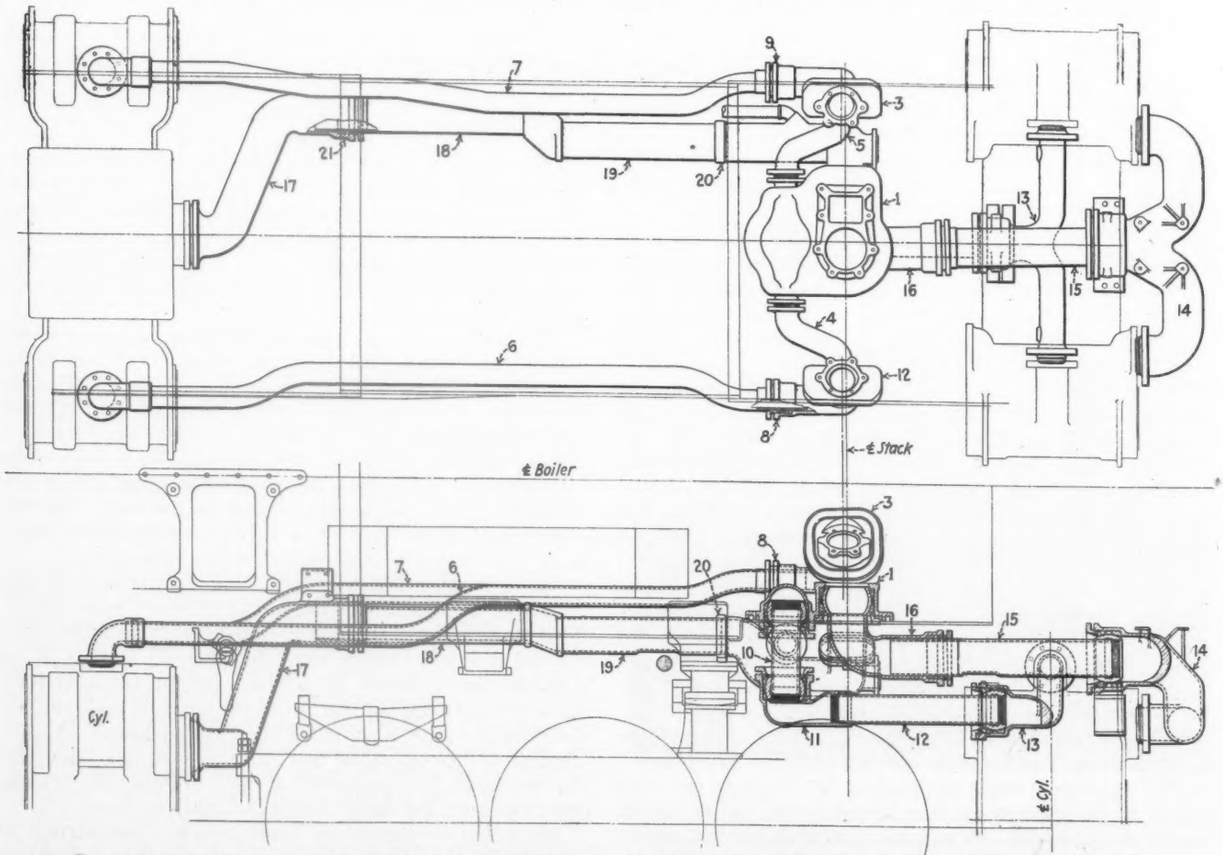
After the steam for the front cylinder passes through pipes *4* and *5*, it enters the live-steam chamber in the combined live- and exhaust-steam header *1*, made of cast steel. Leaving the live-steam chamber, the steam flows through steel pipe *10*, cast-steel elbow *11* and steel pipe *12*, to the cast-steel branch pipe *13*, here being divided and conveyed by branch pipes to the right and left steam chests of the front cylinders. Three lubricated ball joints and no slip joints are involved in this design.

Exhaust steam passes from the exhaust passages of the front cylinders to the cast-iron branch pipes *14*

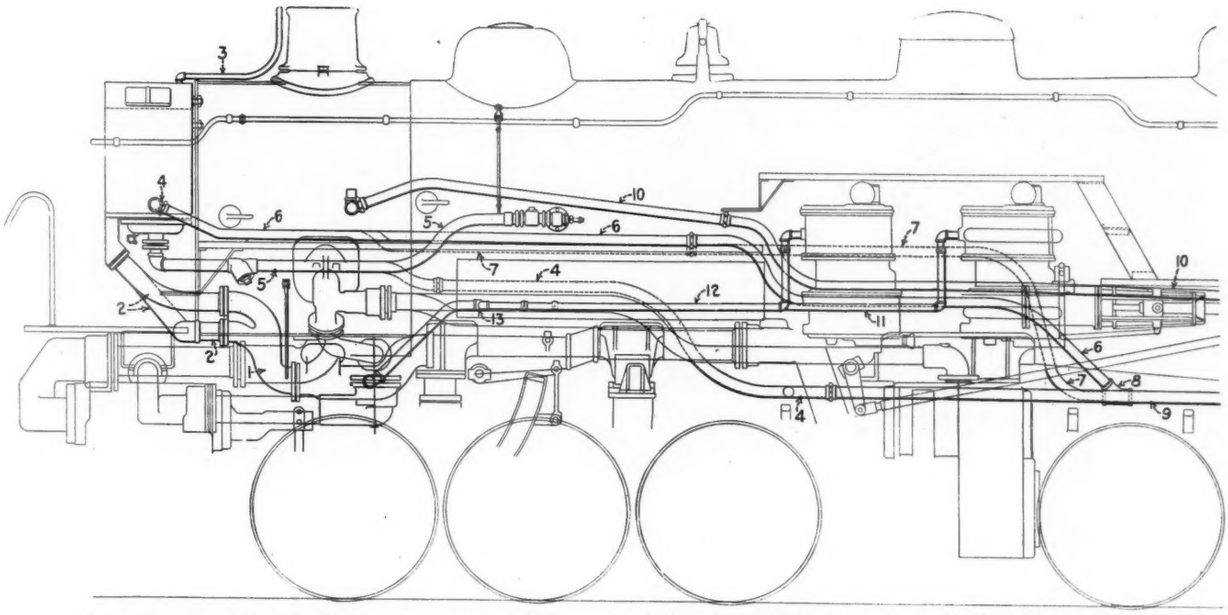


End views of the steam and exhaust pipes

which unite in a single casting and pass the combined exhaust steam from the front cylinders to wrought-iron pipe *15* and cast-iron elbow *16* to the circular exhaust opening in the header casting *1*. It will be noted that but two ball joints and one slip joint are involved in this arrangement. The circular corresponding opening on one side of the exhaust nozzle base gradually



General arrangement of steam and exhaust piping on the Milwaukee single-expansion articulated locomotives



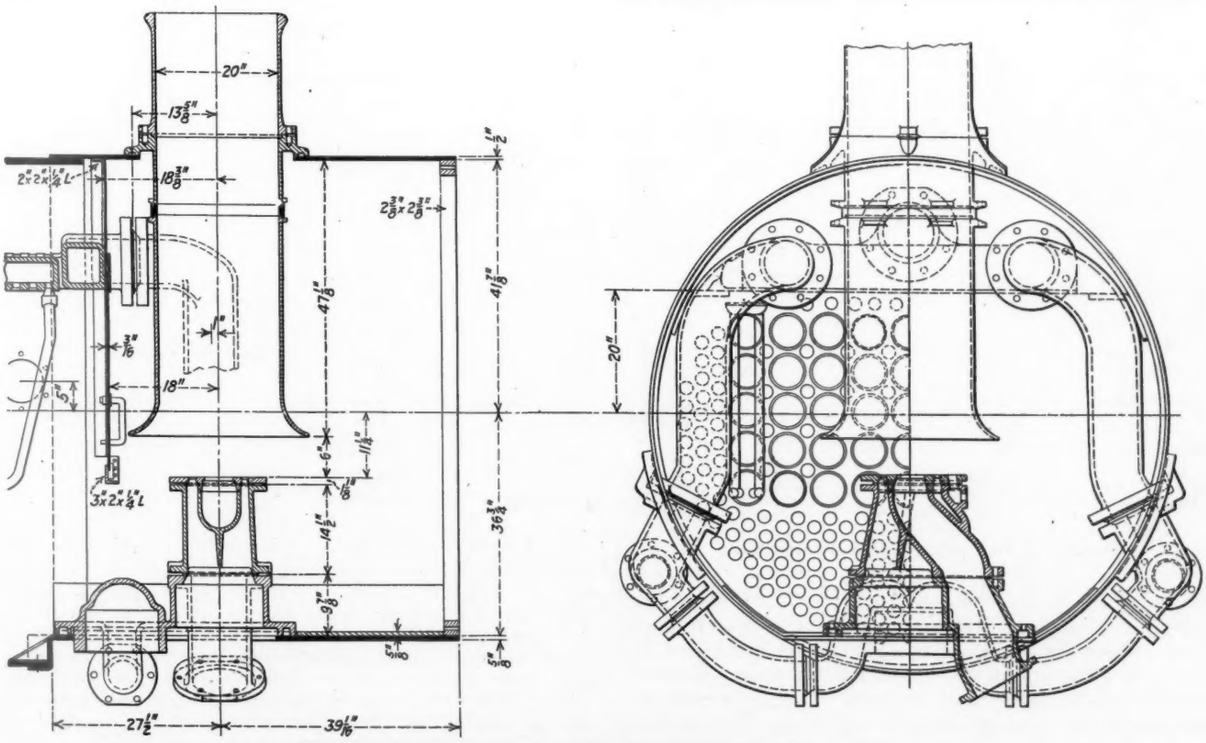
Piping for the Coffin feedwater heater as applied on the Milwaukee single-expansion articulated locomotive

surrounds the center opening in the nozzle until at the top the steam is exhausted through the four slotted holes around the center opening which exhausts steam from the back cylinders. Details of the exhaust-nozzle design are separately shown.

The exhaust steam from the back cylinders passes from the exhaust channels in the cylinders to the cast-iron connecting pipe *17*, then through wrought-iron pipes *18* and *19* on the left side of the locomotive and cast-steel connecting pipe *20*. A single slip joint *21* is provided in the exhaust-steam line from the rear cylinders.

The header connecting pipe is designed to divide the exhaust steam from the back cylinders so that approximately 12 per cent can be diverted to the feedwater heater, the remaining amount passing to the header casting *1*. The steam to be exhausted leaves the header and enters the oblong opening in the exhaust pipe which gradually changes to a circular opening and exhausts through the center circular opening as mentioned.

In this entire steam- and exhaust-pipe design, there are but five ball joints and four slip joints. Brass ring packing is used at all ball joints, which are arranged for pressure lubrication from the force feed lubricators

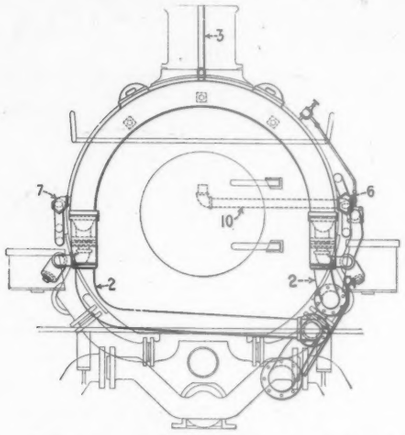


Front-end arrangement notable for unobstructed gas area

through ⅜-in. wrought iron pipe and flexible cable. Neither the ball joints nor the slip-joints, fitted with soft packing, have developed leaks of any consequence since the locomotives were placed in service.

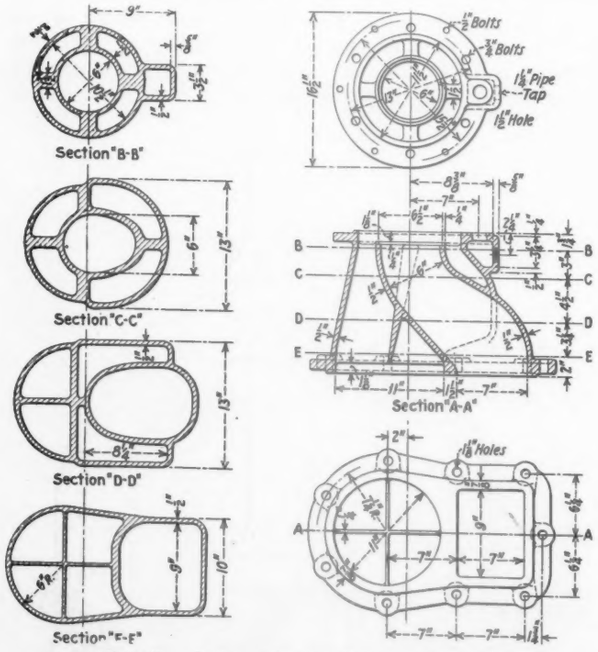
Steam for the Feedwater Heater

Steam for the Coffin feedwater heater leaves the header connecting pipe, passing through a *Y*-fitting *1* and



End view of the feedwater-heater piping

pipes *2*, shown in the feedwater piping drawing, to both sides of the heater, being vented through pipe *3* just ahead of the stack. From the Coffin feedwater pump, located below the left side of the locomotive almost directly under the fireman's seat, the feed pump discharge to the heater is through pipe *4*, the feedwater heater dis-



Details of the exhaust-pipe arrangement

charge of the boiler being through pipe *5*. Pipes *6* and *7* are the condensate drain lines from the heater, there being one on each side of the locomotive joined at Y-fitting *8*. The combined condensate is then delivered through pipe *9* to the tank. Exhaust from the feedwater pump passes to the smokebox through pipe *10*. It will be observed that the exhaust steam from the air compressors passes through pipes *11* and *12*, is united at Y-fitting *13*, and thence passes into the header connecting pipe.

This arrangement of piping for main and exhaust steam as well as for the feedwater heater was designed with a view to maximum compactness, simplicity and reliability. Thoroughly tested construction is used in the ball and slip joints, which are reduced to a minimum in number. The design also minimizes pipes in the smokebox, as shown in one of the drawings, providing ample gas area, in fact, 100 per cent of that available through the tubes and flues. This steam-pipe design was developed under the direction of R. W. Anderson, superintendent of motive power, and C. H. Bilty, mechanical engineer of the Chicago, Milwaukee, St. Paul & Pacific.

Modern Repair Shop for Refrigerator Cars

(*Continued from page 61*)

ber of man-days worked and average units of work per man. These figures are reported to the general office at San Francisco daily by wire. A daily recapitulation is kept at the general office, and weekly and monthly circulars are sent to all shops showing their respective standings.

The classification of shop work under the unit system, developed as a result of a careful analysis and study of eight years' records of labor and material costs, is as follows: rebuilt cars, 482; general-repair cars, 314; heavy-repair cars, 170; light-repair cars, 14; light repair and paint cars, 50. Knowing the average labor cost per car, the total cars per month of each classification and the average number of men employed, it is a simple mathematical matter to develop a schedule of work units and determine how many units each man should produce. Over the period mentioned, it was found that each man turned out 16.7 units per day, and since the system has been in effect, this average has increased materially, largely through keeping the organization in better balance with the amount of work.

The classification "general-repair cars" includes all cars for which the cost of repairing amounts to $250, excluding rebuilt cars. "Heavy repair cars" includes all cars for which the cost of repairs amounts to $100 or more, but less than $250.

The cost of repairs in accordance with the above classification varies with respect to individual cars. However, by the law of averages, no appreciable fluctuations in costs are noticeable. Considerable depends upon the judgment of inspectors and foremen in setting proper classifications for the various cars repaired, and experience of the Pacific Fruit Express Company shows that the shop organization establishes the classification with surprising accuracy.

ALL THIRD-CLASS CORRIDOR CARS and all dining cars of the Great Western of Great Britain are being redecorated in an entirely new color scheme. Upholstery will be gray and black with gray dominating; floors will be gray with black borders; ceilings will be enameled white, and panelling will be in walnut color. This scheme makes the compartments lighter and more cheerful than the old colors of red, black and brown. Seats are also to be made ½ in. wider, and arm rests will be lowered one inch. The exterior of the coaches will remain as at present, chocolate and cream.

Single-sheathed automobile car with end doors—Built for the Missouri Pacific by the Mount Vernon Car Manufacturing Company

Large Number of Cars Ordered in 1929

Total of 121,117 freight and 2,425 passenger cars ordered for service in the United States and Canada

A TOTAL of 121,117 freight cars and 2,425 passenger cars were ordered from builders in this country and Canada during 1929. Freight cars ordered last year for service in the United States totaled 111,218. This 1929 total exceeded that of all years since 1924 when 143,728 freight cars were ordered. Last year, referring to Table I, was also a heavy period for freight car purchases in Canada. A total of 9,899 cars were ordered for freight service in Canada, which is the largest number ordered since 1920 when 12,406 cars were purchased.

Orders for passenger cars since 1918 are shown in Table II. A total of 2,303 cars were ordered for passenger and express service in the United States and 122 for similar services in Canada. This total for passenger-train cars ordered in this country exceeds that of any other post-war year except 1922 and 1924, when the total orders were 2,382 and 2,554, respectively. On the other hand, the orders for passenger train cars in Canada are lower than those for any other years since 1919, with the exception of four—1921, 1922, 1924 and 1925.

Table I—Orders for Freight Cars Since 1918

Year	Domestic	Canadian	Export	Total
1918	114,113	9,657	53,547	177,317
1919	22,062	3,837	3,994	29,893
1920	84,207	12,406	9,056	105,669
1921	23,346	30	4,982	28,358
1922	180,154	746	1,072	181,972
1923	94,471	8,685	396	103,552
1924	143,728	1,867	4,017	149,612
1925	92,816	642	2,138	95,596
1926	67,029	1,495	1,971	70,495
1927	72,006	2,133	646	74,785
1928	51,200	8,901	2,530	62,631
1929	111,218	9,899	3,023	124,140

This February issue marks the tenth consecutive year

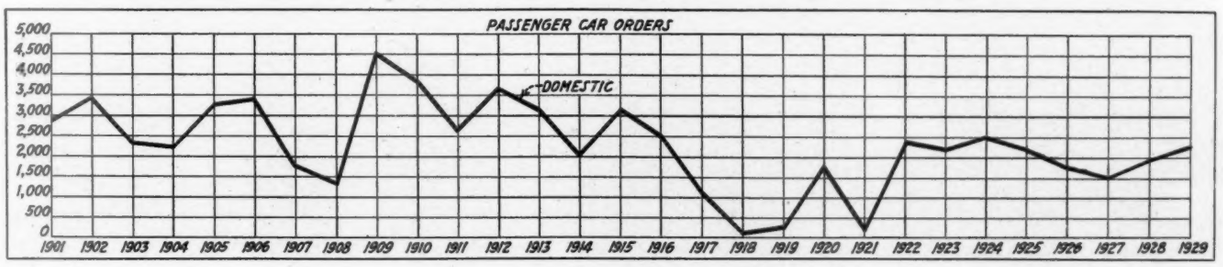


Chart showing the orders for passenger cars from 1901 to 1929

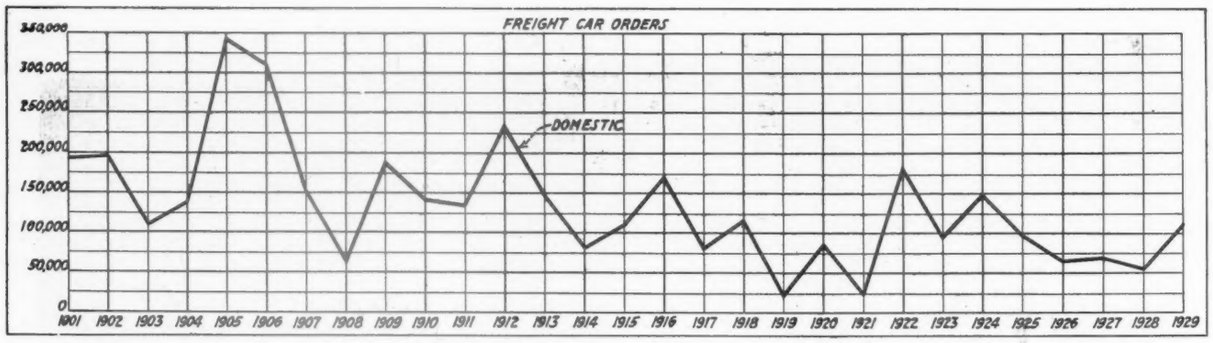


Chart showing the orders for freight cars from 1901 to 1929

in which the *Railway Mechanical Engineer* has reviewed the orders placed during the preceding year for freight and passenger cars, and other types of rolling equipment. Another article reviewing the locomotive and rail motor car orders placed during 1929 appears elsewhere in this issue. Both Tables I and II have appeared in each review article since February, 1921. At that time, the table showed the orders for freight and passenger cars back to 1901. The present table shows the orders placed each year for this type of equipment as far back as 1918, when the federal government took over control of the railroads as a war emergency measure.

Table II—Orders for Passenger Cars Since 1918

Year	Domestic	Canadian	Export	Total
1918	9	22	26	57
1919	292	347	143	782
1920	1,781	275	38	2,094
1921	246	91	155	492
1922	2,382	87	19	2,488
1923	2,214	263	6	2,483
1924	2,554	100	25	2,679
1925	2,191	50	76	2,317
1926	1,868	236	58	2,162
1927	1,612	143	48	1,803
1928	1,930	334	29	2,293
1929	2,303	122	33	2,458

Types of Cars Ordered

Table III shows the types of freight cars ordered in 1929 for service in the United States and Canada. As in 1928, orders for box cars predominate the total purchases during 1929. Of 60,101 freight cars ordered in 1928, 16,662 or 27.7 per cent were box cars. Last year, 47,617 or 39.32 per cent of the total of 121,117 were box cars. Orders placed last year for gondola, hopper and automobile cars were fairly evenly divided, orders being placed for 18,810, or 15.52 per cent, 16,221, or 13.46 per cent, and 17,179, or 14.15 per cent, respectively.

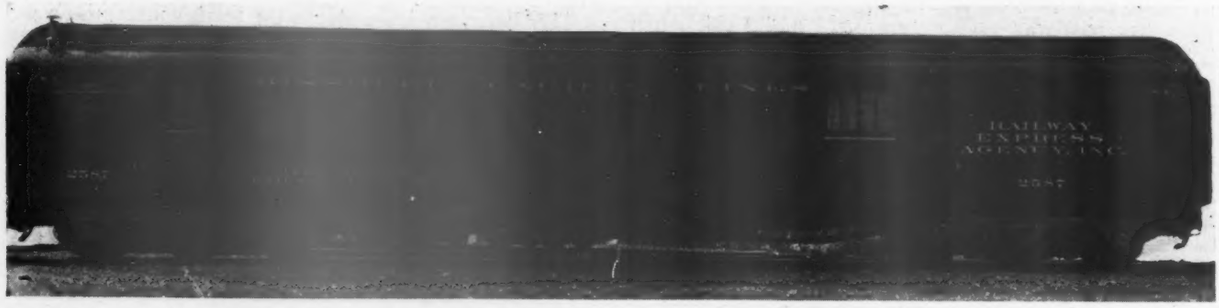
Eighty-five railroads in the United States and Canada purchased freight cars during 1929. The largest order placed by any one road was that of the Atchison, Topeka & Santa Fe for 10,429. Of that number, 5,500 were single-sheathed box cars, 975 were gondola cars, 800 single-deck stock cars, 250 double-deck stock cars, 500 refrigerator cars and 500 automobile cars. The next largest orders for freight cars were those placed by the Chicago, Rock Island & Pacific for a total of 8,500. Of this number, 3,000 were single-sheathed 40-ft. box cars, 1,000 70-ton coal cars, 2,000 70-ton gondola cars, and 1,500 40-ton automobile cars.

Six other roads placed orders during 1929 for more than 5,000 freight cars. The Missouri Pacific ordered a total of 7,835, of which 2,200 were automobile cars. The Baltimore & Ohio ordered 7,601 freight cars, of which 3,500 were double-sheathed box cars, 2,000 70-ton gondola cars and 2,000 70-ton hopper cars. This road also built one 95-ton hopper car. A total of 7,215 freight cars were ordered last year by the Pennsylvania, all but 215 of which were single-sheathed 50-ton box cars. The New York Central placed orders for 7,108, of which 1,500 were double-sheathed box cars, 1,000 double-sheathed automobile-box cars and 2,000 were 70-ton gondola cars. The Chicago, Milwaukee, St. Paul & Pacific ordered 5,465 and the Southern ordered 5,000 freight cars.

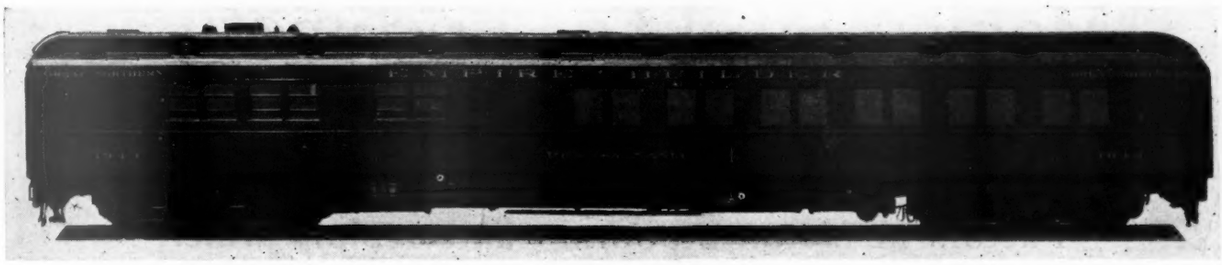
Table III—Types of Freight Cars Ordered in 1929 for Use in the United States and Canada

Type	Number	Per cent
F—Flat and logging	4,922	4.07
G—Gondola	18,810	15.52
H—Hopper	16,221	13.46
R—Refrigerator	3,878	3.19
S—Stock and poultry	2,950	2.43
T—Tank	4,756	3.93
X—Box	47,617	39.32
Automobile	17,179	14.15
Ballast, dump and ore	3,381	2.78
Not classified	572	.47
N—Caboose	831	.68
Total	121,117	100.00

The largest single order for passenger train cars



Mail-express car built for the Missouri Pacific Lines by the St. Louis Car Company



Dining car built for the Great Northern's "Empire Builder" by the Pullman Car & Manufacturing Corporation

placed in 1929 was that of the Pullman Company, which ordered 497 sleeping cars and 60 cars of other types from the Pullman Car & Manufacturing Corporation. The New York Central Lines, with orders for 382 cars, was the largest railroad buyer. The Delaware, Lackawanna & Western ordered 141 multiple-unit coaches for service on the suburban portion of its lines from Hoboken, N. J. to Dover which are now being electrified. Work on the substations and distribution system between Hoboken and Montclair is now in progress and the entire project will probably be completed before the end of this year. Other large railroad orders for passenger train cars came from the Baltimore & Ohio, for 187; the New York, New Haven & Hartford, for 136; and the Atchison, Topeka & Santa Fe, for 107.

It will be noted from Table IV, that the largest number of cars ordered last year with respect to type was for 654 sleeping, parlor, chair and cars designed for through passenger-train service. Of the 382 coaches and 160 multiple-unit cars, 203 were ordered for suburban service. Practically the same number of cars for baggage, express or mail service, and for express-refrigerator service were ordered in 1929. Of the 505 cars of the latter type, 275 were ordered by the New York Central Lines, 200 by the Northern Refrigerator Line, Inc., and 30 by the Canadian National.

Table IV—Types of Passenger Equipment Ordered for Use in the United States and Canada

Type	1926	1927	1928	1929
Coach, combination passenger, etc.	432	760	553	382
Multiple-unit coaches and trailers	237	52	30	160
Sleeping, parlor, chair, etc.	542	238	322	654
Dining	111	111	123	111
Baggage, express, mail	435	422	502	506
Express-refrigerator	125	2	30	505
Milk	60	45	600	30
Horse	95	17	49	40
Private, business, miscellaneous	67	108	55	37
Total	2,104	1,755	2,264	2,425

Table V—Freight Cars Built Each Year Since 1913

	United States			Canadian			Grand
	Domestic	Foreign	Total	Domestic	Foreign	Total	total
1913	176,049	9,618	185,667	22,017	....	22,017	207,684
1914	97,626	462	98,088	6,453	....	6,453	104,451
1915	58,226	11,916	70,142	1,758	2,212	3,970	74,112
1916	111,516	17,905	129,421	....	....	5,580	135,001
1917	115,705	23,938	139,643	3,658	8,100	11,758	151,401
1918	67,063	40,981	108,044	14,704	1,960	16,664	124,708
1919	94,981	61,783	156,764	6,391	30	6,421	163,185
1920	60,955	14,480	75,435	....	....	....	....
1921	40,292	6,412	46,704	8,404	745	9,149	55,853
1922	66,289	1,126	67,415	458	100	558	67,973
1923	175,748	2,418	178,166	....	....	....	....
1924	113,761	1,141	114,902	1,721	....	1,721	116,623
1925	105,935	3,010	108,945	....	....	....	....
1926	88,862	2,771	91,633	1,645	....	1,645	93,278
1927	63,390	1,087	64,477	2,851	....	2,851	67,328
1928	46,060	938	46,998	5,158	....	5,158	52,156
1929	82,240	3,168	85,408	8,557	....	8,557	93,965

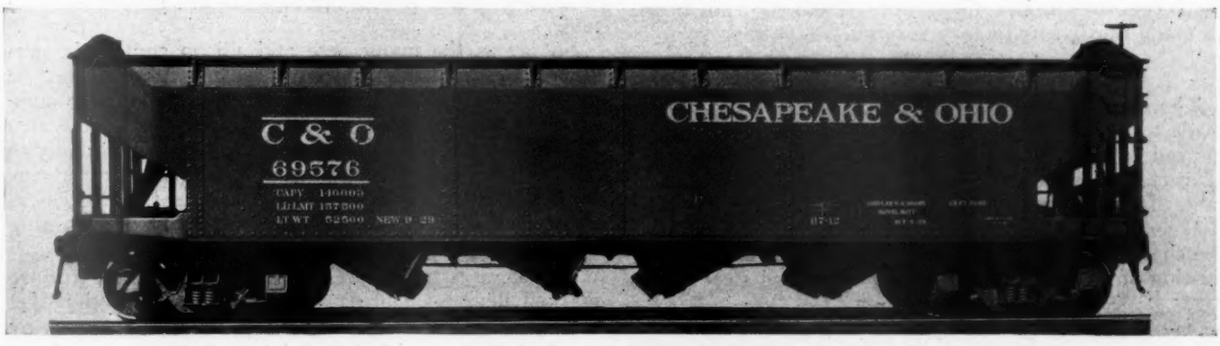
Table VI—Passenger Cars Built Each Year Since 1913

	United States			Canadian			Grand
Year	Domestic	Foreign	Total	Domestic	Foreign	Total	total
1913	2,559	220	2,779	517	....	517	3,296
1914	3,310	56	3,366	325	....	325	3,691
1915	1,852	14	1,866	83	....	83	1,949
1916	1,732	70	1,802	37	....	37	1,839
1917	1,924	31	1,955	45	...	45	2,000
1918	1,480	92	1,572	1	....	1	1,503
1919	306	85	391	160	....	160	551
1920	1,272	168	1,440	....	....	....	....
1921	1,275	39	1,314	361	....	361	1,675
1922	676	144	820	71	....	71	891
1923	1,507	29	1,536	....	....	....	....
1924	2,150	63	2,213	167	....	167	2,380
1925	2,363	50	2,413	....	....	....	....
1926	2,184	102	2,286	285	....	285	2,571
1927	1,785	50	1,835	126	....	126	1,961
1928	1,356	15	1,371	237	....	237	1,608
1929	1,254	20	1,274	162	....	162	1,436

Freight and Passenger Cars Built in 1929

Tables V and VI show the actual production in freight and passenger cars each year since 1913. The production figures shown in these two tables should not be confused with the figures for orders placed that are shown in Tables III and IV. A total of 82,240 freight cars were built by the United States and 8,557 in Canada during 1929. With respect to passenger cars, 1,254 were built in the United States and 162 in Canada. The car manufacturers and car shops of the railroads

(*Concluded on page 79*)



Hopper-bottom gondola car built by the Richmond Car Works, Inc.—Capacity, 70 tons

Making Steel for Locomotive Forgings*

Factors in melting, pouring and cooling which affect the quality of the steel

By Lawford H. Fry

Metallurgical Engineer, Standard Steel Works

THE problem of providing satisfactory forgings for locomotive parts such as connecting rods, crank pins, axles and piston rods is receiving much attention at the present time. Railroad officials and manufacturers are alive to the importance of providing the best possible material and the specifications committees of the American Railway Association and of the American Society for Testing Materials have before them proposed new specifications, which represent considerable advances over the requirements that were standard from 1913 to 1926.

Several factors have contributed to direct attention to the necessity for providing forgings of high quality for locomotives. The trend has been toward locomotive units of larger power and coupled with the increase in load to be carried has come more intensive service for the locomotives and greater insistence on freedom from engine failures.

Present day demands are such, that to produce locomotive forgings which will give good results in service the manufacturer must consider a wide range of problems. It is not enough to concentrate on the process by which the forging is shaped out of a block of steel, and then to see that this is followed by a careful heat treatment, so that on inspection the specified tensile properties are obtained. To secure satisfactory forgings control of the process must begin much earlier. Proper methods must be chosen for the making of the steel. The molten steel must be cast in correctly designed ingot molds. The ingots when cast must be allowed to solidify properly and must be carefully reheated and worked into the billets which go to the forge shop. Correct methods in these preliminary processes are of vital importance to the quality of the finished forgings. In fact the way in which the steel is handled before it reaches the forge shop proper, determines whether or not it can be made into a satisfactory forging.

Manufacture of Steel

The majority of steel used for locomotive forgings is made by the open-hearth process. The electric furnace is used for a comparatively small tonnage, but because of certain advantages is becoming increasingly important. It is in principle an open-hearth furnace, the only difference being that the heat for melting and refining the charge is supplied electrically instead of by the combustion of gas or oil. It offers to the skilled steel maker an excellent tool for the production of high quality steel, but the electric current possesses no esoteric virtue which will of itself prevent the production of poor steel. As with all good tools a skilled workman is necessary to obtain satisfactory results.

In the flame-heated open-hearth furnace two processes the basic and the caid, are used, which differ in the chemical reactions set up. The fundamental principles are however the same in both.

In the processes of the manufacture, the charge of pig iron and scrap steel from which a melt of steel is to be made, will, when charged into the open-hearth furnace, contain more carbon, silicon and manganese than are to appear in the finished steel. When melted the charge will also contain a considerable quantity of undesirable oxides, partly from the original charge and partly due to oxidization of the iron of the charge during the melting period. The amount of oxide in the bath will depend on the care taken in selecting the charge and in the skill used in controlling the melting.

High quality steel requires a selected charge and care in the eliminations of oxides during refining. In this refining operation, which really constitutes the making of the steel, the silicon and manganese in the bath burn away, that is, they take up oxygen from the iron oxide in the bath and slag, and from iron ore added for the purpose. The oxides resulting from this burning rise through the bath and are in part transferred to the slag. The carbon also burns out, but somewhat more slowly. When the oxides have been satisfactorily removed from the bath and when the carbon has been brought down to the desired point, the final additions are made, that is, manganese and silicon are added. The effect of these additions is to carry out a final deoxidization and to "kill" the steel, that is, to drive off or absorb gases which the steel would otherwise contain.

So far as the manganese and silicon content is concerned the final addition of these deoxidizers may be made in the furnace just before tapping, or in the ladle as the steel is poured in. The choice between the two methods of addition will depend on whether economy in cost of production or high quality is given preference. If the additions are made in the ladle the process is slightly cheaper but there is less certainty of obtaining steel of satisfactory quality.

The same is true in respect to carbon, but in a more marked degree. During the refining process the steel loses carbon slowly. To make good steel the process should be so controlled that the steel can be tapped out

* From a paper presented before the convention of the American Society for Steel Treating at Cleveland, Ohio, September 9 to 13, 1929. In a later article Mr. Fry's discussion of the forging and heat-treating process will be printed.

of the furnace just as the carbon content reaches that desired in the finished steel. If the carbon falls too low before tapping, it is possible, so far as composition is concerned, to recarburize by adding pig iron in the furnace or even by adding fine anthracite coal as the steel goes into the ladle. This will raise the carbon content, but is detrimental to the quality of the steel. There is no certainty of uniform reactions throughout the steel and undesirable reaction products may be retained. In open-hearth language the carbon should be "caught coming down."

The principles which have been laid down apply generally to all open-hearth practice, whether the acid or the basic process is used. It has been pointed out that these two processes differ in the chemical reaction involved. This difference is brought about by the refractory materials used to form the furnace walls and the hearth on which the molten metal lies. The furnace itself is a steel structure lined with refractory material to protect it from the intense heat of the furnace chamber in which the steel is melted. In the basic furnace the refractory lining is magnesite or dolomite. The former is largely magnesia while the latter is a mixture of lime and magnesia. With these linings lime can be added to the slag, bringing it into what the chemists call a basic condition. This basic slag has the valuable property of being able to absorb phosphorus from the

Fig. 1—An undesirable forging bloom—Pitting and porosity shown by deep etching

molten steel. Therefore the pig iron or scrap of the charge may have a high phosphorus content and this can be reduced during refining so as to give the low phosphorus content required by the specification. In this country the iron ores producing high phosphorus pig iron are more numerous than those which will produce low phosphorus pig iron. The basic open-hearth process which permits the use of iron of any phosphorus content makes available for the manufacture of steel, ore deposits which could not otherwise be used. It has thus become the most widely used steel making process in this country.

For many grades of steel such as structural shapes, rails, etc., the basic process gives perfectly satisfactory results. For special purposes though, such as the manufacture of forgings of high quality, the acid open-hearth process has important advantages. In the acid open-hearth the furnace lining is of silica and the resulting slag is of an acid nature. Lime cannot be added in any quantity as it would flux or dissolve the silica furnace lining. As a consequence phosphorus cannot be removed from the charge and the charge for an acid furnace must be made up of carefully selected low phosphorus pig iron and scrap. The silica lining and the high silica content of the slag in the acid open-hearth process aid in the reduction of oxides in the steel during refining so that in comparison the basic process falls short in not giving equal facilities for de-oxidization. It is characteristic of the acid process that the slag, which is a dull dirty black color when the steel is first melted, gradually changes color as the oxides are removed during refining and finally in a well made heat takes on a clear olive green color. This change can be easily followed by an experienced steel maker. No such change occurs in the basic slag. For high grade forgings subject to more than ordinarily severe tests the superiority of acid over basic has been repeatedly proven not only in this country but also in England and France. The reason for this superiority is the greater freedom from oxides obtainable in acid steel. The acid slag is a more effective deoxidizing agent than the basic slag so that well made acid steel can be made with fewer oxide inclusions than will be found in equally well made basic steel.

After being finished in the furnace the steel is tapped into a ladle from which it is poured into the molds.

Structure of Ingots

A strong influence on the structure of the forgings is exerted by the conditions under which the molten steel solidifies in the ingot. These conditions which deserve careful consideration are beyond the control of the steel maker except insofar as they are determined by the choice of the size and design of the ingot mold into which the molten steel is cast.

In approaching a study of the structure of forgings as affected by the structure of the ingot it must be borne in mind that the steel solidifying in the ingot mold does not form a uniform structureless solid like a jelly. It freezes, on the contrary, as water does with crystals forming first at the coldest points and growing gradually as the liquid metal cools. The effect that this method of freezing has on the ingot structure is increased by the fact that the steel contains a number of constituents which freeze at different temperatures.

Another important factor influencing the ingot structure is the contraction or shrinkage of the metal during solidification. In an open top mold the steel will solidify on all exterior surfaces and the subsequent solidification and shrinkage of the interior will leave a cavity or "pipe" down the center of the top portion of the ingot. This may require the top third of the ingot to be discarded to insure the use of sound steel only. There is considerable advantage in using an ingot mold of the "hot-top" type producing an ingot such as is shown in section in Fig. 1. In this type of ingot the steel in the upper part has its solidification delayed by using a collar of refractory material to keep the steel from being chilled by contact with the iron mold, and by covering the top surface of the steel with powdered coal or a similar material. With this arrangement the steel in the top remains molten and fills up any space left by the shrinkage during cooling of the steel in the bottom of the ingot. The final solidification leaves a slight depression at the top instead of a deep central pipe.

By etching the central longitudinal section of ingots it is possible to see the structure due to the crystallization of the steel during solidification.

Fig. 2 reproduces a sulphur print from the outer part

of an axial section of an ingot. On the extreme outside can be seen traces of a light colored, noncrystalline skin. This is formed by the first chill of the outside metal. Growing in from this chill skin are to be seen light colored crystal forms, outlined with darker material. From the nature of a sulphur print we know that the darker portions are higher in sulphur, and we assume that they are also higher in carbon and phosphorus because the three elements segregate together. From a print of this sort the mechanism of freezing can be followed. The first crystals of steel which form at the coldest points on the sides of the ingot are comparatively low in the three segregating elements because these elements raise the melting point of steel. As the first crystals grow they make tree-like forms, called "dendrites" from "dendron," the Greek for tree, and are surrounded by liquid metal higher in sulphur, phosphorus and carbon. As the crystals approach each other this liquid is entrapped between their branches and solidifies there.

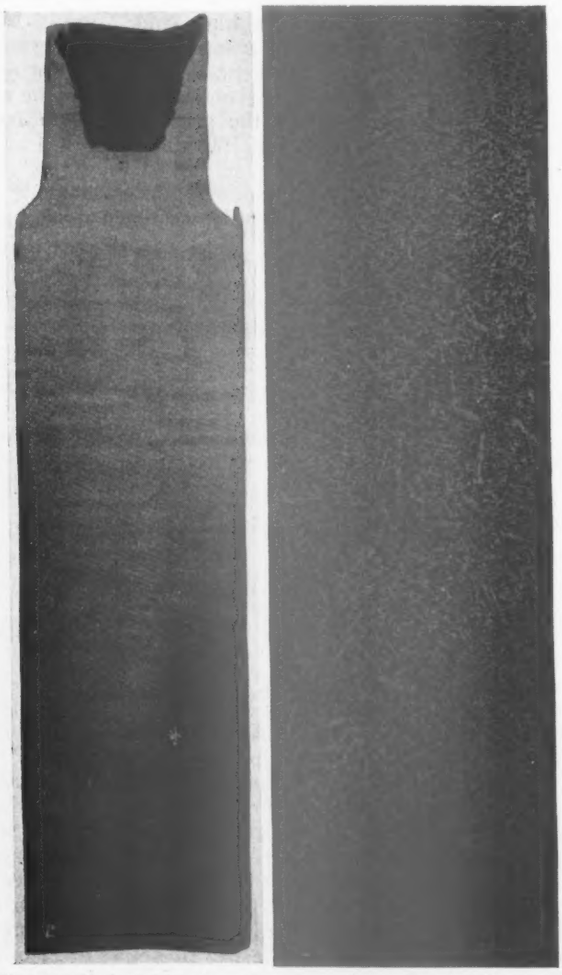


Fig. 2 (Left)—Photograph of section of hot-top forging ingot—All piping is confined to the hot-top, reducing discard loss to a minimum—Fig. 3 (Right)—Sulphur print from outer portion of axial section of a forging ingot—The outer surface of the ingot is at the bottom of the photograph

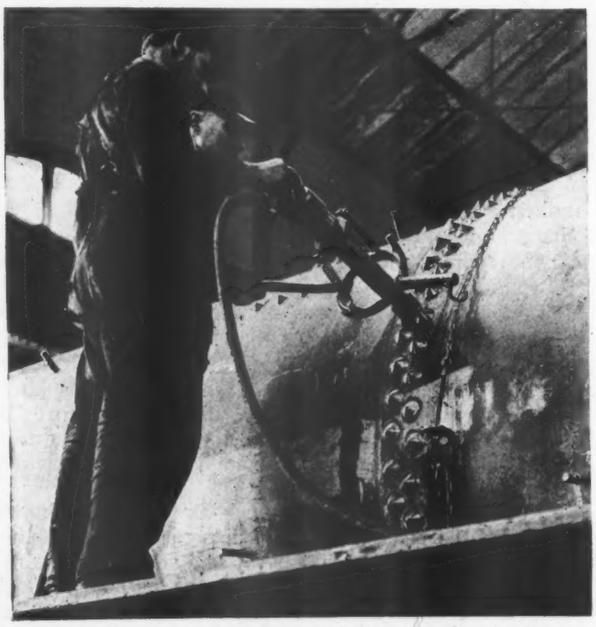
The growth of these columnar crystals does not continue throughout the body of the ingot because, as will be seen later, another type of crystal growth is set up as the rate of cooling slows down.

As each layer of crystals is formed at the sides and bottom of the ingot it is slightly higher in sulphur, carbon and phosphorus than the layer outside it and its formation leaves the liquid metal still higher in these elements. The result is that in the solidified ingot the sulphur, carbon and phosphorus content increases progressively from the lower and outside portion which cools first, up to the top central portion which is the last to solidify. In fact in the zone of final solidification the segregation of the carbon sulphur and phosphorus will be so high that the steel in this neighborhood will be unusable for quality purposes and a portion of the top of the ingot, the amount depending on the size and design of the ingot, must be discarded.

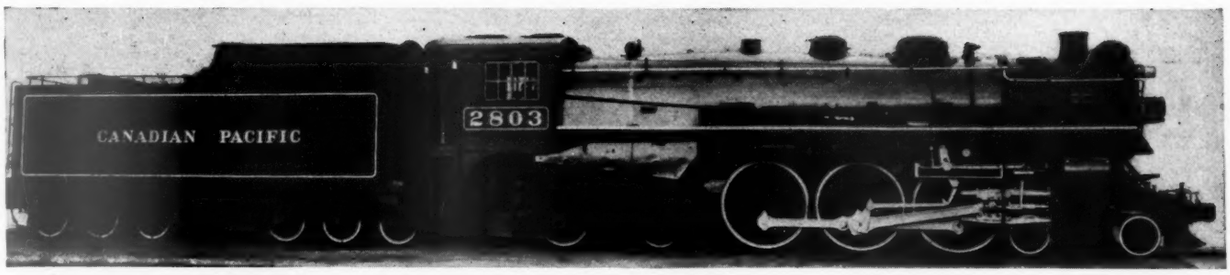
The amount of segregation is dependent on the size of the ingot. In a large ingot the cooling is slow, the crystals grow to a large size. The difference between the composition of the crystal growths and the surrounding metal is greater than in a small ingot and there will be a very considerable difference in composition between the metal which solidifies first and that which solidifies last.

This survey of the structure of the ingot serves to show that the making of the ingot will influence the character of a forging produced from it. During the mechanical process by which the ingot is shaped to a forging the original crystal structure will be distorted and modified and the shape of the nonmetallic inclusions may be changed, but the effect of the original ingot structure will be recognizable in the forging. One effect may be noted here. It is desirable to have in a forging a fine uniform crystal structure and uniform chemical composition. It has been pointed out that the larger the ingot the larger the crystal structure and the greater the diversity of chemical composition, therefore it is desirable to use an ingot no larger than is necessary. During the forging operation the grain size of the steel can be reduced and the patterns made by the crystal growths are elongated, but the variations in composition due to the minor segregation around the crystal growths are not eliminated. Consequently the fiber produced in the forging by the persistence of this minor segregation will be more marked if the original ingot is large.

* * *



Device for speeding-up heavy rivet driving



Canadian Pacific 4-6-4 type built by Montreal Locomotive Works, Inc.

Over Twelve Hundred Locomotives Ordered n 1929

Orders for locomotives and rail motor-cars last year show trend toward increasing capacity

A TOTAL of 1,212 locomotives were ordered last year for service in the United States and 77 were ordered for service on Canadian roads. As shown in Table I, the number of locomotives ordered for service in this country was considerably in excess of the number ordered in 1927 and 1928, and compares favorably with other years as far back as 1923.

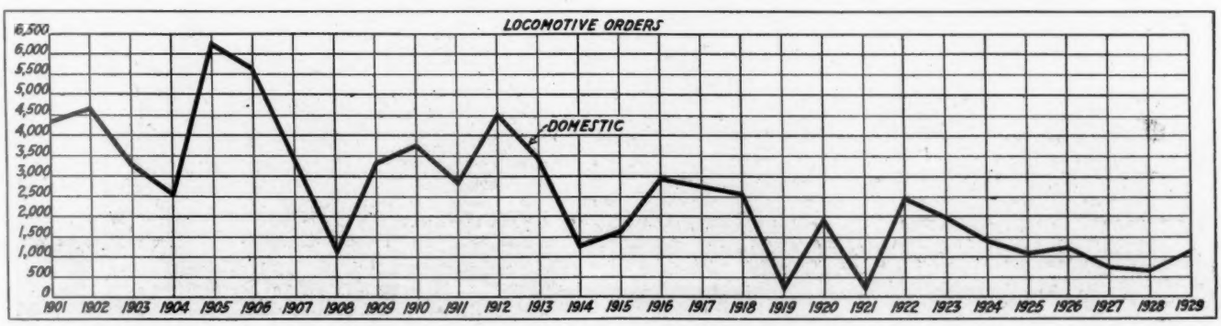
As in 1929, the New York Central with its subsidiary lines, were the largest purchasers of new power last year, ordering a total of 176 locomotives of which 45 were allocated to the Big Four, 15 to the Michigan Central and 91 to the New York Central Lines. The Pittsburgh & Lake Erie ordered 25 eight-wheel switchers. Seventy-five of the locomotives ordered by the New York Central were of the 4-6-4 type, and one of the 4-8-4 type. The remainder of the 176 locomotives ordered were 4-8-2 types. The Burlington, the Rock Island, the Great Northern, Pennsylvania, Southern Pacific and Wabash were also heavy purchasers of new power. Included in the orders placed by the Burlington were one eight-wheel and 20 six-wheel switchers, 12 locomotives of the 4-6-4 type and eight of the 4-8-4. All of these locomotives were ordered in December, 1929. The Rock Island ordered 64 4-8-4 locomotives and five 4-8-2 locomotives, while the Great Northern ordered six single-expansion articulated, 25 2-8-2 and 14 4-8-4 type locomotives. In addition, this road also authorized 41 tenders to be built in company shops.

Table I—Orders for Locomotives Since 1918

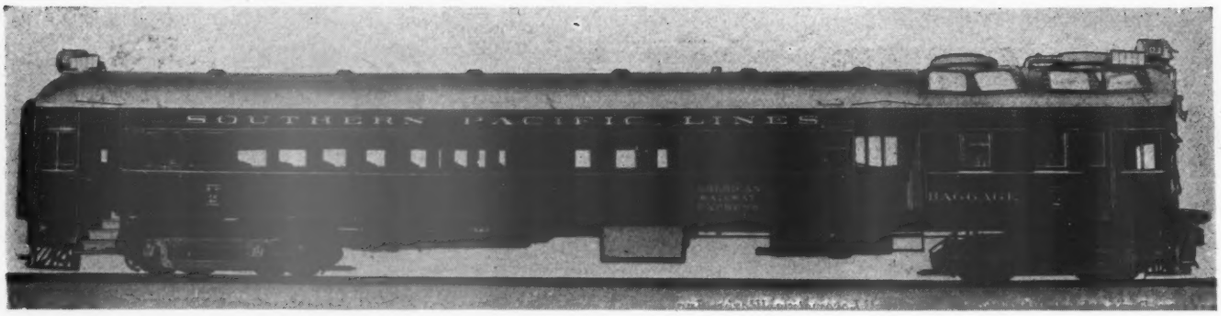
Year	Domestic	Canadian	Export	Total
1918	2,593	209	2,086	4,888
1919	214	58	898	1,170
1920	1,998	189	718	2,905
1921	239	35	546	820
1922	2,600	68	131	2,799
1923	1,944	82	116	2,142
1924	1,413	71	142	1,626
1925	1,055	10	209	1,274
1926	1,301	61	180	1,542
1927	734	58	54	846
1928	603	98	27	728
1929	1,212	77	106	1,395

The Pennsylvania ordered 100 4-8-2 locomotives for freight service.

An interesting order placed in March of last year was



Locomotive orders, 1901 to 1929



A Southern Pacific rail motor car equipped with two 300-hp. Hall-Scott-Westinghouse gas-electric power plants — Car built by the J. G. Brill Company

that of the Southern Pacific for 16 single-expansion articulated locomotives of the 4-8-8-2 type for use in both freight and passenger service. In addition, this road ordered 10 4-8-2 type and 14 4-8-4 type locomotives, and placed an order for 25 more 4-8-8-2 type locomotives in December, 1929. The Wabash ordered 25 locomotives of the 4-8-2 type and 25 of the 4-8-4 type for freight service. The Canadian National was the largest purchaser of locomotives in Canada ordering 10 eight-wheel switchers, 12 4-8-2 type, and 18 2-10-2 type locomotives. Tables II and III show the orders placed for locomotives having four-wheel engine trucks and four-wheel trailing trucks, and two-wheel engine trucks, and four-wheel trailing trucks, respectively.

Table II—Orders for Locomotives Having Four-Wheel Engine Trucks and Four-Wheel Trailing Trucks

Road	Type	No. ordered	Weight, lb.	Tractive force, lb.
Chic. & N. W.	4-8-4	35	498,000	71,800
Can. Pac.	4-6-4	10	351,000	45,300
C. B. & Q.	4-6-4	12	.....	.....
	4-8-4	8	.....	.....
C. M. St. P. & P.	4-6-4	14	384,000	45,822
	4-8-4	1	447,000	62,136
C. R. I. & P.	4-8-4	24	437,000	66,620
	4-8-4	40	434,000	.....
C. C. C. & St. L.	4-6-4	20	.....	.....
D. & R. G. W.	4-8-4	4	498,400	67,000
Great Northern	4-8-4	14	413,000	58,300
Mich. Central	4-6-4	15	348,000	42,300
N. C. & St. L.	4-8-4	5	389,000	70,000
New York Central	4-6-4	40	355,200	53,260
	4-8-4	1	405,000	.....
N. Y. C. & St. L.	4-6-4	4	316,500	40,600
Southern Pac.	4-8-4	14	.....	.....
Timken R. B. Co.	4 8-4	1	410,000	.....
Wabash	4-8-4	25	457,000	70,750

Table IV shows all of the types of locomotives ordered in 1929. Of the 1,177 locomotives ordered for service by the railroads in the United States and Canada, 249 were of the 4-8-2 type, 172 of the 4-8-4 type and 115 of the 4-6-4 type. A total of 141 eight-wheel switchers were ordered by the railroads in 1929.

The trend toward the newer wheel arrangements, especially the 2-10-4 and 4-8-4 types, is well illustrated in Table V. Orders for the latter type during 1929 were divided between 10 different railroads, while five roads placed orders for the former type. There is a decrease in the demand for locomotives of the 2-8-0, 2-8-2, 2-10-2 and 4-6-2 types. It is apparent that many railroads having need for eight-coupled locomotives are favoring the 4-8-2 and 4-8-4 type locomotives. These wheel arrangements can be adapted to designs suitable for both freight and passenger service, and a number of railroads ordered locomotives in 1929 having these wheel arrangements for that reason.

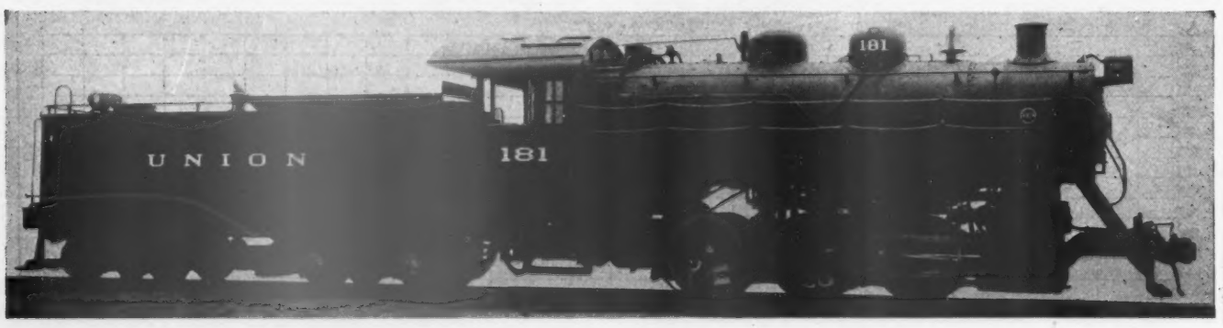
The number of articulated locomotives ordered last year is the largest since 1922. Of the 68 ordered, 58 were single-expansion and 10 were compound. Table V also shows the marked change from compound to single-expansion which occurred in 1925 and 1926. The 10 compound articulated locomotives ordered last year were purchased by the Norfolk & Western.

Oil-Electric Locomotives

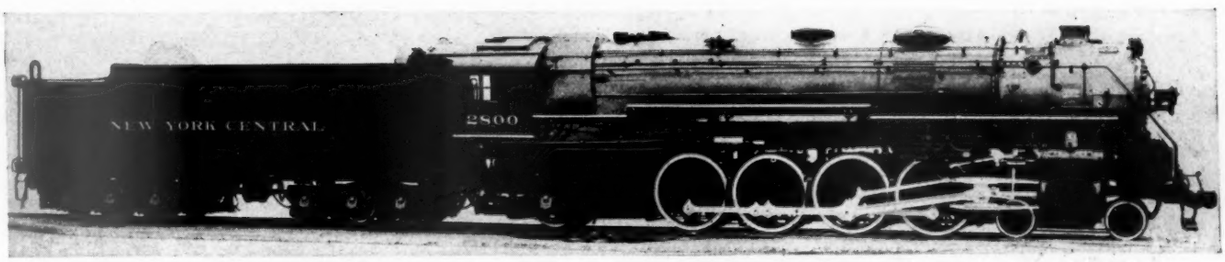
A total of 60 oil- and gas-electric locomotives were ordered by the railroads in the United States and Canada during 1929. One 2-2 type gasoline locomotive was ordered by the Union Pacific for switching service, making a total of 61 locomotives of automotive design ordered last year. Of the 60 locomotives mentioned, six were gas-electric and 54 were oil-electric. Until last year,

Table III—Orders for Locomotives Having Two-Wheel Engine Trucks and Four-Wheel Trailing Trucks

Road	Type	No. ordered	Weight, lb.	Tractive force, lb.
A. T. & S. F.	2-10-4	1	.....	.....
B. & L. E.	2-10-4	1	502,630	96,700
Boston & Maine	2- 8-4	5	404,000	69,400
Can. Pacific	2-10-4	20	452,500	77,200
Chic. Gt. Western	2-10-4	15	.....	.....
Erie	2- 8-4	20	468,800	72,000
Miss. Pacific	2- 8-4	25	.....	.....
Texas & Pacific	2-10-4	15	.....	.....



Six-wheel switch engine built by Baldwin Locomotive Works



New York Central 4-8-2 type built by American Locomotive Company

practically all of the locomotives of this general design were ordered for switching service. The Erie ordered one oil-electric locomotive from the Westinghouse Electric & Manufacturing Company last September for use in passenger service which is scheduled for delivery in May, 1930. This locomotive will weigh 190,000 lb. and develop a tractive force of 23,600 lb. The oil-engine is rated at 600 hp.

The New York Central ordered 39 oil-electric locomotives to be built jointly by the American Locomotive, Ingersoll-Rand and General Electric Companies, four of which have been allocated to the Michigan Central. This order accounts for considerably over one-half of the business in this type of equipment last year. However, in Table V it will be noted that the orders for oil-electric locomotives and power of similar design placed last year exceeded those of previous years, exclusive of the large order placed by the New York Central. Thirteen different railroads ordered locomotives of this class in 1929.

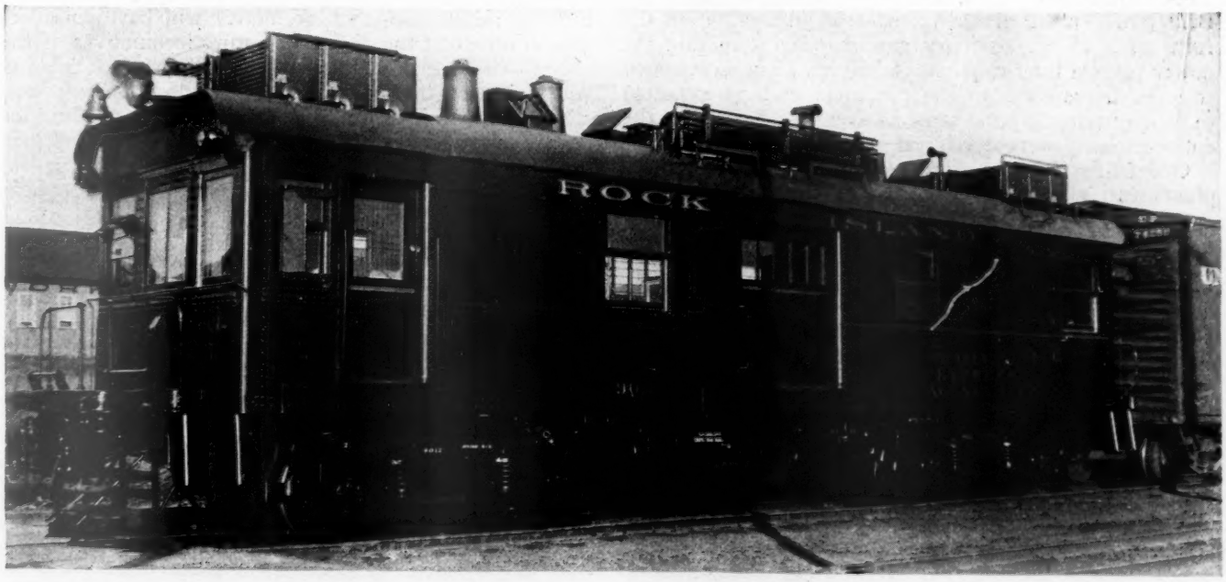
Table IV—Types of Locomotives Ordered in 1929

Type	Railroad	Industrial	Export	Total
0-4-0	0	6	1	7
0-6-0	47	15	0	62
0-8-0	141	3	0	144
2-6-0	0	2	0	2
2-6-2	0	2	2	4
2-8-0	7	4	3	14
2-8-2	79	4	20	103
2-8-4	50	0	0	50
2-10-0	1	0	0	1
2-10-2	22	0	0	22
2-10-4	52	0	0	52
Articulated	68	7	0	75
4-6-0	12	0	0	12
4-6-2	13	0	19	32
4-6-4	115	0	0	115
4-8-0	0	0	2	2
4-8-2	249	0	23	272
4-8-4	172	0	0	172
4-10-2	0	0	5	5
4-12-2	25	0	0	25
Geared	0	16	0	16
Oil-electric or gasoline	61	19	17	97
Electric	62	33	13	108
Unclassified	1	1	1	3
	1,177	112	106	1,395

Rail Motor-Car Orders

A total of 132 rail motor-cars were ordered by the railroads last year for service in the United States and Canada. A comparison of the number of rail motor cars ordered in 1929 with previous years is shown in the last column of Table V. The total figures for rail motor-car orders shown in this table will not check with those shown in Table VI, because trailers and rail motor cars ordered by industrial companies and for export are included in the latter tabulation.

Table VII shows the power-plant capacities of rail motor cars ordered for railroad service in the United States and Canada during the past five years. A comparison of weights is shown in Table VIII. It will be noted that there has been a steady increase in the demand for heavier and more powerful rail motor cars. In 1928, but 27 per cent of the motor cars ordered were equipped with power plants exceeding 350 h.p. in capacity. Last year the power plants of over 76 per cent of the cars ordered were rated at over 350 h.p. Relative to weights, 45 per cent of the rail motor cars ordered weighed more than 125,000 lb. Last year 64 per cent



A motor car equipped with two 400-hp. Electro-Motive power plants—Built by the St. Louis Car Company

Boston & Maine 2-8-4 type built by Lima Locomotive Works, Inc.

of the cars ordered exceeded 125,000 lb. in weight and one group of seven cars weighed approximately 180,000 lb. each. These cars, each of which is powered with two 400-hp. engine-generator units, are in reality light locomotives which will be used as such in both passenger and freight service by the Chicago, Rock Island & Pacific. Because they are provided with 11-ft. baggage compartments, however, they may also be classed as rail motor.

Designs for at least two eight-cylinder gasoline engines for rail-car service have now been developed which have horsepower ratings of 500 or over. The eight-cylinder 8-in. by 9-in. Sterling-Viking engine is designed to develop 500 hp. at a crankshaft speed of 1,150 r. p. m. This engine weighs 7,850 lb. The designs for the new cars which are powered with a new six-cylinder, 9-in. by 12-in. Westinghouse solid-injection oil engine designed to develop 400 hp. at 900 r.p.m. The power plant for these cars, including the engine and generator, complete with the bed plate, weighs 18,000 lb. The engine, complete with flywheel and bedplate, weighs 11,000 lb.

Orders for five cars equipped with Railway Locomotor steam power plants, developing from 400 to 500 hp., were placed during the year.

Orders for Unusual Locomotives

The year 1928 marked another year in which the record was broken with respect to the largest locomotive built in the world, with the delivery by the American Locomotive Company in December of that year of a

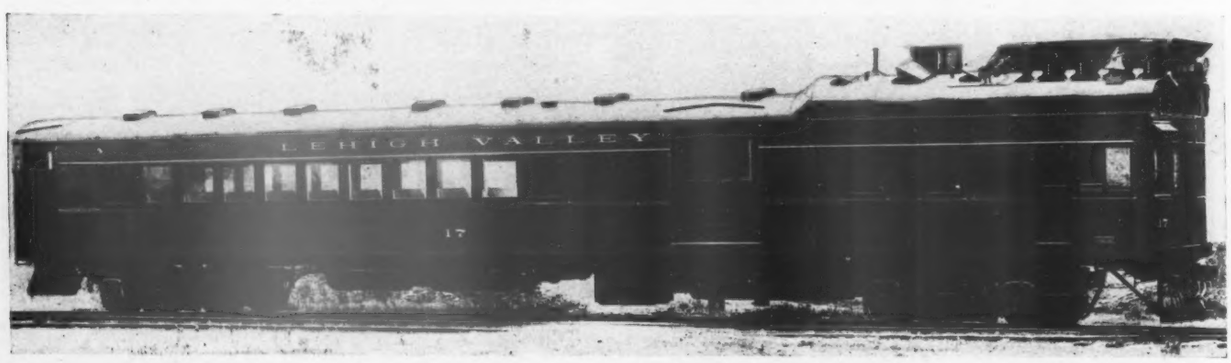
Table V—Orders Placed by the Railroads in the United States and Canada During the Past Eight Years, for the Principal Types of Steam and Internal-Combustion Locomotives and Rail Cars

										Articulated			Diesel,	Rail
Year	2-8-0	2-8-2	2-8-4	2-10-2	2-10-4	4-6-2	4-6-4	4-8-2	4-8-4	Simple	Compound	Total	Oil-Electric or Gasoline	Motor-Cars
1922.....	73	1,231	0	157	0	299	0	158	0	0	116	116	0	49
1923.....	71	534	0	167	0	194	0	140	0	0	53	53	0	71
1924.....	61	582	0	31	0	167	0	113	0	4	30	34	0	112
1925.....	17	247	25	115	10	93	0	235	0	21	1	22	14	136
1926.....	31	220	70	25	0	193	15	326	22	0	17	17	15	135
1927.....	9	71	82	17	47	49	59	30	61	22	0	22	13	164
1928.....	6	55	42	15	46	7	35	151	63	28	0	28	4	163
1929.....	7	79	50	22	52	13	115	249	172	58	10	68	61	132

Brill eight-cylinder engine have been based on 8¾-in. by 10½-in. cylinders to develop a rated horsepower of 535 at a conservative crank-shaft speed of 950 r.p.m. This engine will weigh approximately 10,000 lb. The Brill power plant design includes an innovation in the form of a 15-hp. auxiliary gasoline engine, giving the power plant a total capacity of 550 hp. The investment cost per horsepower of the combined units is expected to be approximately the same as would be the case if the entire capacity were developed in the major unit.

Orders for 10 cars equipped with oil-electric power plants were placed during 1929. Among these are eight single-expansion articulated 2-8-8-4 type to the Northern Pacific. It is reported that the locomotive is performing satisfactorily in regular freight service. Its performance is being carefully observed. Undoubtedly, the results of the experience with this locomotive will have considerable influence in the design of future locomotives of the articulated type. A number of railroads are looking with favor on the articulated type of locomotive as the solution of traffic problems, especially over divisions having heavy grades that serve somewhat as a "neck in the bottle" in moving trains over the entire system.

The year 1929 a more intensive study of the applica-



A 600-hp. motor car with Electro-Motive dual power plants—Built by the Osgood-Bradley Company

tion of certain requirements to the design of locomotives to secure increased capacity, rather than the securing of the same objective by increasing the size. Two orders for locomotives of the so-called Schmidt double-pressure type were placed in 1929, one for the Canadian Pacific

Table VI—Orders for Rail Motor Cars and Trailers

	1922	1923	1924	1925	1926	1927	1928	1929
For service in U. S.	51	77	120	149	142	180	175	132
For service in Canada	7	3	12	7	4	9	10	10
For export	1	22	..	34	32	12	9	28
Total	59	102	132	190	178	201	194	169
Motor cars	50	93	112	171	161	176	172	159
Trailers	9	9	20	19	17	25	22	11

and one for the New York Central. These locomotives will have double-pressure boilers, the high-pressure portion of which will generate steam at about 800 lb. working pressure by indirect evaporation, and the low-pressure section will generate steam at about 200 lb. pressure, which will be used to supplement the exhaust steam from the high-pressure cylinder in supplying the low-pressure cylinders.

Table VII—Power-Plant Capacity of Rail Motor Cars, U. S. and Canada

Horsepower	1925	1926	1927	1928	1929
100 or less	13	14	2	5	6
Over 100 to and including 125	5	7	..	1	3
Over 125 to and including 150	9	..	..	4	1
Over 150 to and including 175	20	1	..	1	..
Over 175 to and including 200	49	3	3	1	..
Over 200 to and including 250	36	65	43	13	2
Over 250 to and including 300	2	26	76	64	15
Over 300 to and including 350	..	..	..	30	2
Over 350 to and including 400	2	..	..	18	64
Over 400 to and including 450	..	8	7	6	2
Over 450 to and including 500	..	11	1	4	5
Over 500	..	..	8	15	30
Unclassified	..	..	24	1	2

Designs are now being prepared for another high-pressure locomotive for the Delaware & Hudson. This locomotive, which in general arrangement and working principle will follow the ideas of John E. Mulfeld already incorporated into locomotives now in service on

Table VIII—Comparison of Rail Motor Car Weights, U. S. and Canada

Weights	1925	1926	1927	1928	1929
25,000 and under	6	7	..	3	3
Over 25,000 lb. to and including 50,000 lb.	19	7	..	4	6
Over 50,000 lb. to and including 75,000 lb.	74	2	4	4	..
Over 75,000 lb. to and including 100,000 lb.	27	79	29	16	5
Over 100,000 lb. to and including 125,000 lb.	7	32	88	62	20
Over 125,000 lb. to and including 150,000 lb.	..	5	21	58	54
Over 150,000 lb. to and including 175,000 lb.	..	..	..	11	24
Over 175,000 lb.	..	1	..	..	7
Unclassified	..	..	26	5	13

the Delaware & Hudson, will operate at a pressure of 500 lb.

One of the most striking design innovations of last year's orders for locomotives is the application of roller bearings to the journals of locomotive axles. An order for a locomotive was placed in July with the American Locomotive Company by the Timken Roller Bearing Company, in the construction of which such an application of Timken bearings is to be incorporated.

THE WIDESPREAD OWNERSHIP of the railroads is strikingly illustrated in the case of the Illinois Central. A recent compilation showed that there were 20,800 registered holders of Illinois Central stock, 87 per cent of whom owned fewer than 100 shares each. Wyoming is the only state in the Union which is not represented by an Illinois Central stockholder.

Large Number of Cars Ordered in 1929

(*Continued from page 71*)

of both countries produced during 1929 a grand total of 93,965 freight and 1,436 passenger cars.

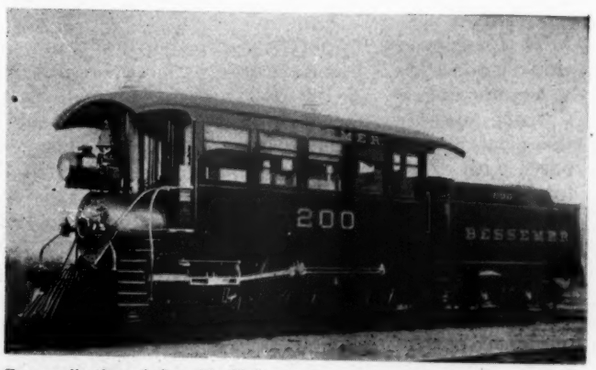
Comments on Design of Equipment Ordered Last Year

An interesting feature of the freight cars ordered during last year was the predominance of open-top cars of 70-ton capacity. The orders for 40-ton and 50-ton capacity house cars appeared to be fairly evenly divided. No marked innovations in freight-car design or equipment were brought out during the past year. The outstanding developments pertaining to freight cars were the completion of the laboratory tests of draft gears undertaken by the Mechanical Division of the American Railway Association in a test plant at Purdue University. The past year has also seen the completion of the first part of the freight car air-brake test program of the Mechanical Division and definite progress in the second part of the program. The rack tests conducted at Perdue University have been completed and the road tests are now under way on the Siskiyou line of the Southern Pacific in northern California and southern Oregon.

For several years the outstanding development in passenger equipment has been the increasing attention paid to architectural treatment and ornamentation of the interiors of passenger cars and to the appointments affecting the comfort of passengers. During the past year a number of railroads have extended this attention from the individual coaches to entire trains, and several trains with de luxe appointments for coach passengers have been inaugurated.

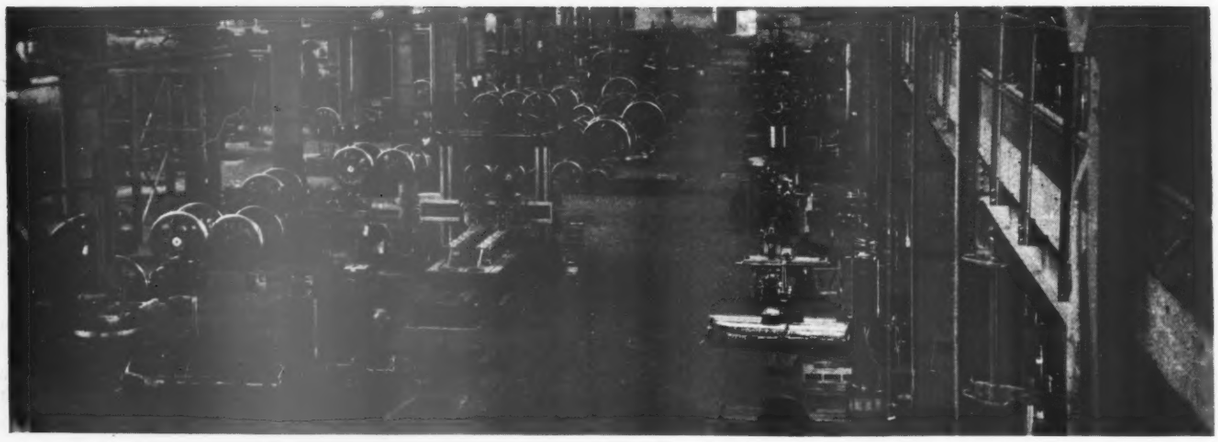
BECAUSE he lacked the required height to satisfy a lifelong ambition to become a railway man, John Mathews, a Chicago plumber built his own railroad on a miniature scale. Two years were needed to build it, the rolling stock consisting of a locomotive, a tender and two cars. The locomotive, with its tender, is 4 ft. 6 in. long, weighs 115 lb., and has a working steam pressure of from 90 to 120 lb. Last year Mr. Mathews displayed his train in London at the Model Engineering Exhibition. There the locomotive set a record by hauling 17 persons at one time. A bronze medal, a diploma in model engineering, and a silver loving cup were awarded Mr. Mathews.

* * *



From collection of Geo. M. Sittig

Inspection locomotive on the Pittsburgh, Bessemer & Lake Erie



Machine Tool and Equipment Orders of 1929

Increased orders indicate modernizing to decrease maintenance costs

THE gradual increase in the number of units of machine tools and shop equipment purchased by the railroads during the past three years seems to indicate a steady replacement program of obsolete material to build up economical shop operation for the reduction of maintenance costs. A realization of the fact that maximum economies in the maintenance of modern power and rolling stock can only be effected by the utilization of modern shop facilities is borne out by the large orders for shop machinery placed by those railroads which have also been relatively heavy purchasers of new cars and locomotives. Although one railroad reported the erection of new shops in 1929 that necessitated the purchase of 498 units of shop equipment, the general trend appears to be toward the elimination of obsolete tools and machinery under a carefully considered replacement program to make repair facilities as modern as the cars and locomotives.

This survey of the purchases of shop tools and machinery for 1929 is based on orders placed for this type of equipment by 88 railroads of the United States, Canada and Mexico which represent 89 per cent of the total route mileage of the continent. This compares with 87 railroads representing 85 per cent of the total route mileage reporting in 1928, 99 railroads representing 88 per cent of the total route mileage in 1927, and 97 railroads representing 84 per cent of the total route mileage in 1926. Although the number of roads reporting their purchases has fluctuated somewhat during this period, the total route mileage represented has remained practically constant.

The table showing the fluctuations in the purchases of machine tools and shop equipment over a six-year period reveals 1926 as the peak year when 3,457 units were ordered. The general industrial expansion of the south that resulted in the abnormal traffic demands on the southern roads was the principal factor responsible for the large orders of locomotives, cars and necessary maintenance equipment placed during 1926. With the recession in the southeast, the orders fell to 2,172 units in 1927.

During 1928, the standard types of machine tools such as engine lathes, boring mills, drill presses, planers, shapers, slotters and grinding machines, continued to decrease but to no large extent as compared with 1927, there being 707 units ordered in 1927 and 597 in 1928. However the total number machine-tool and shop-equipment units purchased have steadily increased since 1927, there being 2,172, 2,377 and 2,691 units ordered in 1927, 1928 and 1929, respectively. When

Purchases of several types of material-handling equipment are increasing

comparing the trends of orders placed for various types of lathes it is interesting to note that turret-lathe purchasers have increased, on a proportional basis, faster than any of the others. It is apparent that the railroads are turning more and more to the turret lathe in an endeavor to reduce maintenance and production costs, because of its adaptability in roughing out crank pins, all types of bolts, smaller pins, and bushings besides making fitted bolts for frames, crossheads, valve-motion parts, etc. The turret lathe product is rapidly replacing the more or less poorly fitted bolts generally made on engine lathes that are frequently of an antiquated type and wholly inefficient for this important duty.

Last year the railroads purchased 35 wheel lathes, more than double the number purchased during the preceding year. Orders placed for milling machines have increased during the past three years.

The railroads continue to purchase woodworking machinery in considerable quantities. Orders were placed for 124 units in 1927, 110 in 1928, and 130 in 1929. This type of machinery includes wood borers, mortisers, surfacers, tenoners and saws. In spite of the steady growth in the number of steel passenger and freight cars, the number of these machines ordered each year indicates that the railroads are steadily improving their wood mills.

The outstanding increase in the purchases of any single class of shop equipment has taken place in the orders for material-handling equipment, which includes overhead cranes, air, electric and chain hoists, gasoline, electric and trailer trucks and car and locomotive hoists. This class of equipment is the only one which exceeded at any time during the past three years the peak of purchases established in 1926. The orders placed for material-handling equipment during the past five years, beginning with 1925, are 433, 594, 509, 810 and 766 units respectively. The types of equipment in this class orders for which show a marked increase during 1929 as compared with 1928, are overhead cranes, car and locomotive hoists, gas trucks and electric hoists. Orders placed for overhead cranes during 1929, increased 114 per cent over those placed in 1928, while orders for electric hoists and gas trucks increased 300 per cent and 93 per cent, respectively, over the figures for the preceding year. The decrease in the total orders for this type equipment in 1929 was a result of the fewer purchases of air and chain hoists and electric trucks.

The modernizing of shops and important repair points is a development which follows the advances made in the elimination of many intermediate terminals and small shops and directly results in a concentration of repairs at large engine terminals and back shops.

Stack Loss and Grates

By F. P. Roesch

Sales Manager, The Standard Stoker Company, Chicago

RECENT discussions apparently indicate that those having to do with fuel costs and fuel conservation on American railways are gradually coming to an appreciation of the value of grate design and its effect on the so-called stack loss.

As far back as 1898 in the days of narrow and deep fireboxes, the advantage of ample air opening under the grate was recognized but, owing to the then prevailing type of ash pan, was not always found possible of practical application. About 1902, when the wider type of firebox was being introduced, the first constructive steps toward the free admission of air into the ash pan and under the grates was taken but, even then, under protest from those who insisted that dropping the pan below the mud ring was the cause of side sheet failures and staybolt leakage. This opening was, therefore, often kept to the minimum that permitted the cleaning of the sloping sides of the pan. Gradually, however, this prejudice was overcome and the pans lowered, until today we find few locomotives where the free opening under the grates through or over the pan is not equal to 14 per cent of the total grate area, tests indicating that this amount is necessary to avoid a partial vacuum in the ash pan under maximum rates of fuel consumption or draft.

Here again, however, possibly because our line of reasoning was not carried to a logical conclusion, another error crept in insofar as grate design was concerned. Generally speaking, grates were considered simply as a medium for supporting the fuel and, as the advantage of plenty of opening under the grates was proved an aid to combustion, the conclusion was reached that a design of grate with an equally free admission of air through the grates would be of equal advantage, not only from a combustion standpoint but also that it would assist in the elimination of clinkers and, last but not least, would permit the rapid dumping of fires at terminals.

Perhaps the latter was the determining factor in grate design, the thought being to reduce the time of cleaning fires to the minimum and so decrease this expense, overlooking entirely the loss between terminals due to imperfect combustion, etc. Be this as it may, the fact remains that until recently we find but few instances where grates were designed with any other end in view. Granting that the theory was good as far as it went, yet in the light of subsequent developments it is clear that no real attempts were made to establish the soundness of the conclusions by actual tests of various types of grates under all conditions of service and different kinds of coal.

Experiments with "Restricted" Grates

A few years ago the engineers of the Atchison, Topeka & Santa Fe, perhaps more with a view to reducing the cinder discharge when using western sub-bituminous coal than for any other reason, began to experiment with what they termed a "restricted" grate, i. e., a grate wherein the air openings through the grates were restricted in size as well as in proportion to the total

grate area, and found therein a partial if not a complete solution to their problem. They did not broadcast the results of their experiments, however, and it was not until the Northern Pacific was faced with the same problem in connection with Rosebud coal, a sub-bituminous semi-lignite coal, that the Santa Fe type of grate began to attract attention.

When the Northern Pacific uncovered the immense deposits at Colstrip and endeavored to burn it in their locomotives, it was found that some change in grate design was absolutely necessary. Their engineers visited various railroads that were burning a somewhat similar fuel and, as the result of their investigations, fixed on the Santa Fe design, with some modifications, as best adapted for the purpose. More than that, however, they found that this design of grate, rechristened the Rosebud type, was not only well adapted to handle the sub-bituminous coals but was equally satisfactory in connection with the true bituminous coals regardless of ash content, clinkering tendencies, etc.

There is nothing radical about this design. It simply consists of an ordinary table grate with small air openings equally spaced and the grate bars are so designed that they fit neatly against one another and against the side and center bearers so as to leave no openings at these points substantially greater than the openings through the grate itself. A preference is expressed for round holes as apparently there is less tendency for these to stop up than with slotted openings of equal area.

We now come to the crux of the matter. The common practice has been to provide air openings through the grates equal to from 30 to 55 per cent of the total grate area. The Santa Fe and Northern Pacific designs limit this opening to from 12 to 18 per cent and here, we feel, will be found the logical solution of the entire problem.

Definite Air Control Through Grates Preferable

We know that we require approximately eleven pounds of air in the combustion of one pound of bituminous coal, and about one-half as much per pound if lignite. In tests conducted by the Bureau of Mines, it was found that with a fire from six to eight inches deep, supported on standard locomotive grates, there was a deficiency of air above the fire so that the greater part of the volatile gases passed off unburned. Where the fire was carried at a lesser depth, particularly with lump coal, a surplus of air obtained, again resulting in imperfect combustion.

This naturally raises the question: Should we have a definite restriction through the grates, or a haphazard restriction based on the depth of the fire and the judgment or lack of judgment, as you please, on the part of the firemen? Really, there seems to be but a single answer.

Let us assume a grate of the restricted type with a total air opening equal to 15 per cent of the total grate area. Then let us assume a maximum consumption of 200 lb. of bituminous coal per square feet of grate per hour. (We are intentionally taking high rates to emphasize the problem). Tests indicate that it is well to supply about 50 per cent more air than the theoretical requirements. Therefore, we have 200 lb. times 11 plus 50 per cent equals 3,300 lb. of air per hour per square feet of grate. The combustion of 200 lb, of coal per square foot of grate per hour will require about two inches difference in pressure above and below the fire. One square foot equals 144 square inches. Fifteen per cent of that is 21.6 square inches. The flow of air in pounds per second per square foot of orifice can be calculated from the following formula:

$$W = 0.6299\ d^2 \sqrt{\frac{i}{T}}\ C$$

For the purpose of this article, however, which is simply a discussion and, therefore, involves no calculations carrier out to the nth degree, the standard pressure—velocity—volume tables reversed will serve.

We then have:

P=2 in. of water
Velocity=5,768 ft. per min
Volume=40.06 cu. ft. per min.

Converting volume into weight, we have approximately 4,147.2 lb. of air per hr. through orifices equal to 15 per cent of area for each square foot of grate, or more than enough to meet the theoretical requirements, showing that where the total air opening is equal to from 15 to 18 per cent of the total grate area, the supply of air is ample, even allowing for the partial restriction of the flow due to the fuel.

Let us now consider the question from a combustion and fuel-saving standpoint. True, good combustion and fuel economy usually go hand in hand, but we are looking at the whole problem and from all angles.

Small openings through the grates prevent fuel loss when firing up. They also prevent holes being torn in the fire when starting or when the engine slips and the fire happens to be rather thin. Small openings evenly spaced will give a better diffusion of air through the fuel bed and enable the fireman to carry a level thin fire, all of which tends toward better combustion. But more than all this, small openings through the grates will materially reduce the stack loss regardless of the size of the coal fired, as it has been found that the lifting action of the air jet is proportional to its volume more than to its velocity.

Small air jets spread rapidly as they leave the orifice, with consequent reduced velocity and carry power. On the other hand, with comparatively large openings through the grates there is always a tendency, where the flow of air is restricted by the depth of the fire, to overcome the vacuum at the point of least resistance; i. e., where the fire is thin, and this in turn causes the formation of holes through the fire, through which the blast rushes with cyclonic velocity, carrying with it not only the smaller particles of coal with which it comes in contact but even larger lumps. With the inflow of air restricted by the grate itself, these miniature tornadoes cannot form and, consequently, even the smallest pieces of coal will continue to dance above the fire until, by combustion, their specific gravity has been reduced to a point where the draft current alone will carry them, still giving us a cinder discharge from the stack, but not a fuel loss.

Several Designs Superior to Round-Hole Grate

The writer holds no brief for any particular design of grate. There are several patented designs on the market that, from a combustion standpoint, are, no doubt, superior to the restricted round-hole type mentioned; the question was only raised in order to impress those concerned with the necessity or, at least, advisability of giving this phase of locomotive design more study in order to reduce fuel costs through the use of the cheaper grades of fuel, particularly where the locomotives are mechanically fired, instead of purchasing selected coal to overcome a stack loss which, as shown above, is due more to grate design than to the character of the coal fired.

Union Pacific Buys New Diners

New roof, ceiling and side deck arrangement— Distinctive features of interior decoration incorporated

THE Union Pacific has recently received five dining cars from the Pullman Car & Manufacturing Corp., the most interesting features of which, from a structural standpoint, are the arrangements of the roof, ceiling and side decks. In these members, the mouldings, panels, etc., ordinarily introduced to obtain lights and shadows, are not used, but in their place a series of coves are employed, resulting in unusual light and shadow effects.

All former dining cars on the Union Pacific, constructed of steel, were provided with a handsome mahogany interior finish. At the time the new diners were being constructed, however, the trend toward the general use of steel trim in such cars was recognized and it was decided to use colors freely in the interior treatment, but in such a way as to obtain a subdued and dignified effect. This plan was carried out in such a way as to produce a highly attractive and distinctive treatment.

An interior with an unusually distinctive decorative treatment

The cars have clere-story roofs and end diaphragms without platforms. The six-wheel trucks have Commonwealth cast steel frames and integral pedestals, Simplex clasp brakes and Standard rolled steel wheels. The length of the car is 82 ft. 11½-in. over buffers. The dining room is 38 ft. 9 in. long and is provided with six tables, each seating four people, and six tables, each seating two people, giving a total seating capacity of 36. The kitchen is 19 ft. 7 in. long by 6 ft. 7 in. wide. The pantry is 8 ft. 10 in. long by 6 ft. 7 in. wide. Between the pantry and the dining room, there is a lobby 6 ft. 1 in. long by 8 ft. 10 in. wide. At the steward's end a bulkhead is placed 6 ft. from the end of the car. In this compartment is placed a refrigerator, crew's locker, etc., and through the center of the compartment there is an entrance lobby 6 ft. long by 4 ft. wide. Between the kitchen and pantry and the side of the car there is a passageway 2 ft. 1 in. wide, provided with a swinging door.

The windows throughout the car are 4 ft. 3 in. wide and are of the double type. The outside and inside panes of polished plate glass are mounted in aluminum bottom rails, which carry the combined locks and lifts. The glass tracks in felt runways at the sides, and the

top and bottom of the window are weatherproofed by felt packing. This window construction provides maximum vision, and is weather, dust and rattle-proof, features which are very necessary in a dining car.

The heating apparatus is of the latest type Vapor system. Automatic heat control is provided, two thermostats being placed in the dining room and one in the passageway, thus insuring an even temperature throughout the car. An extra amount of radiating surface is installed, especially at the ends of the car, in order to insure against cold zones at these points.

Ventilation of the dining room is provided by induced draft deck ventilators. Five electric paddle ceiling fans are placed in the dining room, and there are two electric exhaust fans in the kitchen and one in the pantry.

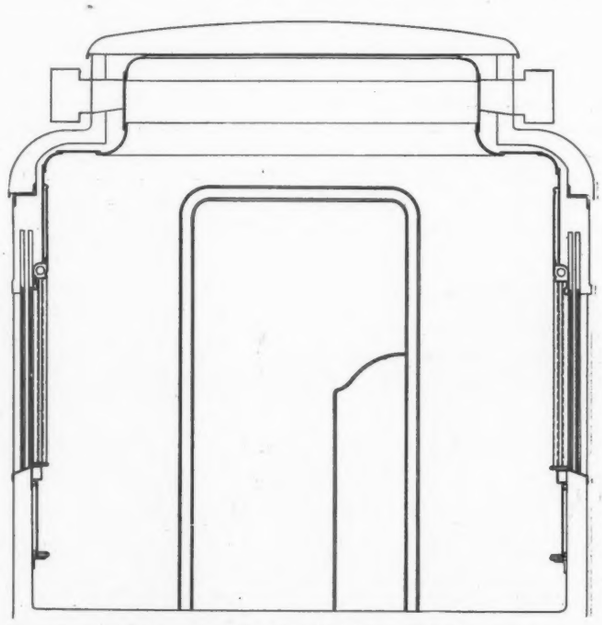
The arrangement of the kitchen and pantry is the same as in the last previous order of Union Pacific diners, but the refrigerator, lockers, etc., have been, rearranged in the steward's lobby. The arrangement of the switchboard, linen lockers and water fountain, in the vicinity of the sideboard, has also been modified.

Specialties Used on the Union Pacific Dining Cars

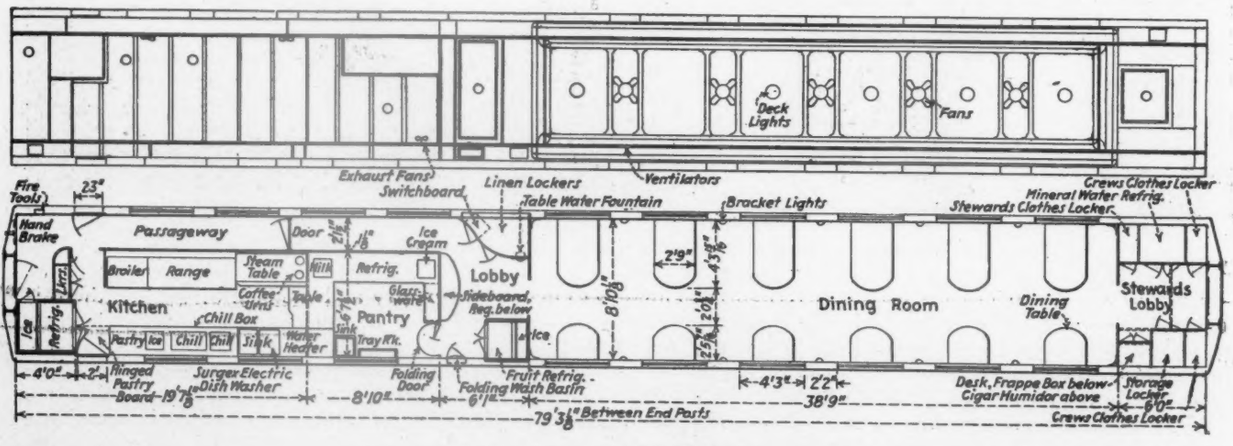
Equipment	Manufacturer
Air brake and air signal equip.	The New York Air Brake Company, New York
Axles	St. Louis Forgings Company, Chicago
Brake shoes	American Brake Shoe & Foundry Co., Chicago
Couplers	National Mall. & Steel Castings Co., Chicago
Dust guards	W. N. Thornburgh Manufacturing Co., Chicago
Draft gear, type A-5-XB	W. H. Miner, Inc., Chicago
Journal bearings	Magnus Co., Inc., Chicago
Journal box lids, bolts, etc.	National Mall. & Steel Castings Co., Chicago
Journal boxes	Gould Castings Corporation, Kansas City, Kan.
Side bearings	The Q & C Company, Chicago
Springs	Railway Steel Spring Company, Chicago
Safety bolster lock. center pins.	W. H. Miner, Inc., Chicago
Integral-pedestal six-wheel truck	General Steel Castings Corporation, Commonwealth Division, Granite City, Ill.
Solid wrought-steel wheels	Standard Steel Works Company, Chicago
Axle-lighting equipment	The Safety Car Heat. & Lighting Co., Chicago
Storage batteries	Edison Storage Battery Company, Orange, N. J.
Body bolsters	Commonwealth Steel Company, Granite City, Ill.
Brake handles	Robert H. Blackall Company, Pittsburgh
Simplex clasp brake equipment.	American Steel Foundries, Chicago
Vestibule curtains and rollers	Morton Manufacturing Company, Chicago
Window and door curtains	The Adams & Westlake Company, Chicago
Vest. diaphragms and attach.	The Adams & Westlake Company, Chicago
Electric paddle fans	The Safety Car Heat. & Lighting Co., Chicago
Water heaters	The Stearnes Company, Chicago
Heating equipment	Vapor Car Heating Co., Inc., Chicago
Lighting equipment	The Safety Car Heat. & Lighting Co., Chicago
Candle lamps	The Adams & Westlake Company, Chicago
Refrigerators	Bohn Refrigerator Company, St. Paul, Minn.
Sashless-type window fixtures	The National Lock Washer Co., Newark, N. J.
Buffing device, Class B-10-X	W. H. Miner, Inc., Chicago
Dining chairs	S. Karpen & Brothers, Chicago
Elec. light. train connectors	The Pyle-National Company, Chicago
Ventilators	Railway Utilities Company, Chicago
Window screens	Tuco Products Corporation, Chicago
Folding wash stands	The Adams & Westlake Company, Chicago
Exhaust fans	The Safety Car Heat. & Lighting Co., Chicago
Coffee urns	The Stearnes Company, Chicago
Steel ranges	The Stearnes Company, Chicago
Water filters	Midgley & Borrowdale, Inc., Chicago
Ampere-hour meters	Sangamo Electric Company, Springfield, Ill.
Air brake and air signal hose.	Hendrie & Bolthoff Mfg. Co., Denver, Colo.
Dishwashing machines	The Stearnes Company, Chicago
Duralumin floor mats	Irving Iron Works Company, Long Island City, N. Y.
Novelty lamps	Commonwealth Edison Company, Chicago
Etching on aluminum window rails	The Greenduck Company, Chicago

New Standards of Interior Design Developed

The cars were planned without regard for previous standard interior designs. Since steel was to be used throughout, it was decided not to utilize the ornaments or mouldings formerly employed, which are more adaptable to wood trim. The typical deck cornices, for example, are eliminated. In these cars, the members joining one surface with another are of rolled or formed



Cross section showing the interior finish and the window construction



Floor and ceiling plans of the Union Pacific diners

steel, consistent with the part that each member plays in the plan as a whole. The trim, surrounding the doors and windows, is of well modeled form, and with no sharp corners, the design depending entirely upon coloring, form and good proportions.

The walls of the passageway and lobby are finished in a light almond brown, a color that seems to expand the width dimensions of the passageway. These foyers to the principal compartment are treated with studied simplicity. The hardware used is of oxidized silver, and the floor is covered with a rubber tile in a combination of brown and black.

Fully-equipped steward's lobby occupies six feet in one end of the car

Finished in Metallic Colors

The surfaces in the dining room are all finished in metallic colors, allowing the background of the materials to retain their identity. The scheme is a combination of gun metal, oxidized blue, old gold and oxidized brass and copper, all mellowed to a rich, soft depth and luster. There is little in the way of embellishment or ornament. Decorative treatment is provided in a combination of metallic finishes and ornamentations on the deck cove and the over-window panels, which seem to blend into the background.

The ceiling is of rich cream on which there is an absence of decoration except for fine gold and black lines.

There are no sharp angular projections from the ceiling to the floor. On the contrary, a series of curvilinear effects avoids arresting attention from the balance of the car. In the four corners of the compartment are placed coves, thus avoiding all sharp angles.

No cross panels were used in the lower decks, this treatment preventing the appearance of length from becoming foreshortened by transverse battens. The lower deck extends across the bulkheads at each end of the compartment, the ceiling finish being carried down the bulkhead to the lower deck, thereby providing a room effect instead of the usual hall effect.

Window Bottom Rails of Aluminum

The aluminum window bottom rails are etched in a suitable design. The window sills are of black laminated Bakelite, which enhance the effect of the metal window rails by the contrast. They also provide a durable material which is non-inflammable and non-soluble.

In the construction of the sideboard at the end of the dining compartment, all exposed woods are of walnut, Carpathian elm and ebony, finished in a tone that does not destroy the wood's beauty. Ivory lines are used for contrast. The mirror is a half-circle of silver plating, joined to a convex half of black plating. The silver mirror, separates the black half from the Bakelite top, upon which is placed an electrically-lighted ornament.

The Lighting Fixtures

The lighting fixtures, made especially to serve the two-fold purpose of illumination and ornamentation, are of moulded glass and polished brass. In the center of the ceiling, the lighting fixtures alternate with fans of the same general design, and side fixtures are placed in each panel between the windows.

Window shades of striped silk material temper the light and soften the coloring by the relation of color values. The background is in a soft metallic blue, while the stripes are in old copper, bordered by fine silver and gold lines further bordered by black pencil lines, running with the broad stripes. The floor is covered in a special chenille carpeting of dark brown or rust background, and of an unobtrusive conventional floral design.

Chairs Were Especially Designed

The chairs, made of walnut, were especially designed for these cars, and are shaped to provide comfort and convenience. They have fully upholstered seats and backs. The outside of the backs are recessed or panelled, permitting the chair frames to be seen from the rear. A hand-hold is provided to move each chair about conveniently and a basket arrangement is placed below the seat in which to place a hat. The upholstery material of special design conforms to the coloring used throughout the car.

Interior of the new Union Pacific diner looking toward the sideboard lobby

The entire treatment of the interior of this car and its furnishings is characterized by the simplicity of the ornamentation and by a sincere recognition of the metallic surfaces which are utilized to produce new and beautiful effects.

EDITORIALS

Write to the Editor

IN a recent conversation with two mechanical department officers relative to the article "Inspecting the Main Tracker for Long Runs" which appeared in the January issue, one remarked, "If two air-brake inspectors and two air-brake repairmen handle sixteen 100-car trains in twenty-four hours, they must do it on roller skates. They certainly do not make many repairs and the inspection cannot be very thorough. Frankly, I think he (referring to the author) has his figures all balled up."

We suggested that they write letters to the editor presenting their views on the subject, and incorporating in their letters any pertinent questions they would like to have answered. If they did not desire to sign their names, the letters could be published on the Reader's Page without disclosing their identity. Both, however, expressed their reluctance to follow such a procedure, saying that "they hated to write for publication."

They overlook the fact that there might be others who have the same questions in mind, and by asking some pertinent questions or expressing their opinions on specific claims or statements in the article, others would be induced to do likewise. Why not give all readers the opportunity to profit by a constructive discussion?

Renovating Journal Packing

IT is evident from the large amount of data and information that has been collected and studied by the editorial staff of the *Railway Mechanical Engineer*, that the renovation of car-journal packing is an economical practice. One eastern road which handles over 350,000 loaded freight cars each month, in addition to a large number of local and through passenger trains, obtained a saving in one year's time of over $150,000 in the cost of locomotive and car lubrication through the use of renovated packing produced from one plant. At the same time it operated its trains with an average of 1,136,000 passenger-car miles per hot box and 105,300 freight-car miles per hot box. Another road using the same renovating process operated its trains with an average of 1,300,000 passenger-car miles per hot box and 32,000 freight-car miles per hot box. The first road compiled its figures from data in which it counted as a hot box any journal causing a delay to trains enroute or requiring attention in a terminal or at destination, while the latter road counted a hot box as a journal requiring attention enroute, in terminal, or at destination. Both roads are now compiling their hot-box statistics on the latter definition.

During one year, a total of 10,237,405 lb. of packing was received at three renovating plants of a large railroad. Of this material 9,179,005 lb. was returned to service and 9,937 gal. of oil was used in the renovating process. A total of 21,212 lb. of babbit was salvaged. In comparison, 145,796 gal. of new oil was used to produce 1,607,207 lb. of prepared packing made from new waste, an average of two and one-half pints of oil being used for each pound of packing prepared from new materials.

Relative to lubrication costs, one road has averaged approximately four cents per 1,000 passenger-car miles and less than three cents per 1,000 freight-car miles. Another road averaged three cents per 1,000 passenger-car miles and slightly over two cents per 1,000 freight-car miles. The first road used some packing made from new materials, while the second used renovated packing entirely, including the journals of locomotive and tender trucks. This, in all probability, accounts for the difference in lubrication costs between the two roads.

It should be stated that all of the roads from which data have been obtained, have followed a policy of constant education and close supervision of the men engaged in inspecting, packing and maintaining car journals. However, such a policy requires good materials with which to do the work, and it is evident that packing properly renovated will accomplish the desired results and at considerably less expense.

Joint Meetings

THE success of the joint meeting which the New York Railroad Club held on January 17 with the Metropolitan section of the American Society of Mechanical Engineers and the Manhattan Air Brake Club, leads to the suggestion that much could be accomplished if other railroad clubs and associations were to do the same in planning their programs. A number of engineers and others employed in industries other than railroading, were present at that meeting. Although none took part in the discussion of the paper, which was on the subject of air brakes, many expressed their gratification after the meeting at being able to hear a paper on such a subject. It was apparent that they had felt the evening had been profitably spent. A number of mechanical engineers present also expressed considerable surprise in learning that so much had been accomplished since 1869 in the retardation of freight and passenger trains. In fact, one man claimed that he did not know that the air brake had ever been improved since it was first invented by George Westinghouse. He remarked that after all, the railroads were not so backward as he had been led to believe.

There are a number of railroad clubs and associations, the interests of which are allied more or less closely with the fields covered by various technical societies with which an occasional joint meeting might be arranged with mutual profit. The International Railroad Master Blacksmith's Association, it is understood, is already planning to hold its annual convention in the same city and at the same time that the American Society for Steel Treating and the American Welding Society are holding their annual conventions. The Railroad Division of the A.S.M.E. has also adopted the policy of holding joint meetings with other societies, meetings of this nature having been held during last year with the American Society of Refrigerating Engineers and the Oil and Gas Power Division, of the A.S.M.E.

Joint meetings during annual conventions cannot help but be profitable to the members of all participating organizations. They will not only conserve the time of the busy mechanical department officer by affording him an opportunity to take advantage of the proceedings of several associations, but they also give him the oppor-

tunity to make a selection of subjects in which he is interested, from a larger program. Joint meetings tend to improve the quality of the papers and reports which are presented. They afford railroad men the opportunity to get new light on their own problems by studying the methods by which others approach their closely allied problems and, last but not least, they afford an opportunity for the development of a mutual understanding of accomplishments, which cannot help but be beneficial in building up good will.

Gaging Worn Wheels

ONE of the pertinent questions raised at a recent meeting of the Car Foreman's Association of Chicago related to the method of gaging cast iron car wheels worn through the chill. The specific question was: "Should the worn-hollow gage be used for checking the wheel, and how much wear is permissible?" The answer developed in the discussion by C. T. Ripley, chief mechanical engineer of the Atchison, Topeka & Santa Fe and past chairman of the Wheel Committee, was that, to protect against possible damage to trucks or other car parts, when any flattening is developed due to the chill being worn through, the wheel should be taken out at the first terminal regardless of whether the car is loaded or unloaded. The tread worn-hollow gage is useless in testing for this defect. The standard method prescribed in the Wheel Manual is to take any flat-back gage or a flat piece of steel and run it over the tread of the wheel. Any flattening will then be obvious and afford sufficient justification for taking the wheel out of service since, if permitted to run until it reached the tread worn-hollow state, equipment, roadway and lading will probably be damaged, and loss and damage claims result. Obviously, cars loaded with perishable commodities should not be cut out at intermediate terminals for wheel defects unless they are real and potentially dangerous, and it was the concensus of the meeting that flange wear limits are set sufficiently high to permit cars going through to destination unless the wheel has started to wear flat.

Coach Seating Facilities

IT can hardly be questioned that seating facilities in the average railroad coach leave much to be desired in the way of comfort and are responsible, to some extent, for the loss of passenger-coach business. In many cases, the seat spacing is inadequate for anything like a comfortable lounging attitude and the hard cushions and straight backs are an effective antidote to napping. Modern chair cars are not always available on trains which business men, constituting a large proportion of of the traveling public, like to ride and, consequently, these men, rather than risk the weariness associated with a 5- to 7-hour ride in day coaches, in many cases make reservations for travel by Pullman when the surcharge earned by the road is inadequate to pay the Pullman guarantee. On trains equipped with chair cars, traveling men with limited expense accounts and the general run of the traveling public may not feel like paying the extra charge for the chair-car seats and are consequently faced with the alternative of riding in the poorly-equipped day coaches or securing transportation over the highways in busses or other motor vehicles. From several points of view, the railroads have a decided advantage over highway vehicles in any effort to secure maximum passenger comfort and can ill afford to overlook this factor in any possible attempts to regain passenger coach business lost to the highways.

With the development of the long-haul bus came the bucket-type seat, employing double-deck spring construction with the upper springs upholstered as nearly air-tight as possible and giving in effect an air cushion. Always cramped for space, the bus designers limited seat center spacing but stressed the importance of pitch of the cushion and of the back, the thought being to develop a design which would take the weight off the feet of the passenger. During recent months, bus operators have decided to increase their seat center-spacing from approximately 30 in. to 38½ in. Many railroads, with far less imperative necessity for space conservation, are using passenger coaches with a seat spacing of 38 in. or less. One large railroad in the Middle West, however, has just placed in service some newly-equipped modern 64-passenger coaches with rotating reclining-back bucket-type seats, with 43-in. center spacing which permits having all seats face the windows, when passing through scenic country, or being set at any angle most convenient for small groups of 4 to 6 people who may be traveling in a party.

One of the principal arguments raised against use of the modern reclining-back seats, with or without the rotating feature, is that they reduce the total seating capacity in the car. Of what use is it, however, to have a high seating capacity which is seldom, if ever, used. For the handling of big passenger loads, such as football specials, etc., some of the older high capacity cars may well be used to advantage but these peak load requirements occur infrequently and, during most of the year, the primary objective of the railroads is to attract sufficient passenger traffic to pay expenses. Those responsible for the design of railroad passenger-coach equipment can not afford to overlook the possibilities of rendering more attractive and desirable service by utilizing the most modern seating facilities.

Grates, Combustion and Draft

IN an article elsewhere in this issue F. P. Roesch presents a very interesting discussion of the reasons for the success which has attended the use of grates of the so-called round-hole type.

This type of grate, in which air is admitted to the firebox through circular openings of small size, has produced some surprising results. Developed at the outset primarily to reduce the size of openings through the grate to prevent excessive ash-pan losses of fuels of certain characteristics, the restriction of the air opening, in some cases to as little as 12 per cent of the total area of the grates, was forced by limitations of foundry practice as the price which had to be paid for the small openings. To restrict the area through which air may enter the firebox to so small a proportion of the grate was contrary to the generally accepted ideas as to the essentials of grate design, and the success with which practicable combustion conditions have been maintained under such conditions has been a source of amazement and, in some cases, of skepticism on the part of many railroad officers and engineers.

It is unnecessary here to discuss the case for restricted

air openings; Mr. Roesch has covered this ground in his article. There are, however, two points for further consideration.

It is undoubtedly true that the thin fire has eliminated the fire bed as the primary restriction to the flow of air into the firebox and made the grate the controlling factor at this point. Through the round-hole grate the air enters the firebox in small jets relatively widely spaced and between these jets the grate area is "dead" so far as the distribution of air to the solid fuel on the grate is concerned. One may readily see that this condition exists by a look into the firebox of a locomotive equipped with these grates when the fire is burning clear enough to permit the fire bed to be seen. The location of each hole in the grate is clearly indicated by the stream of incandescent gas rising from it. The question suggested by this condition does not concern the amount of air entering the firebox, but is whether or not this air is most effectively distributed.

The second question concerns itself with back pressure. Considering the fact that the air passes through the grate at temperatures probably varying from 60 to 120 deg. F. and that the gases enter the tubes at temperatures from 1,200 to 2,000 deg. and leave the tubes at temperatures of 500 to 600 deg. F., it is evident that several times the volume of gas must be moved through the tubes and flues, the net gas area of which is seldom greater than the restricted area of the air openings in the round-hole grates. It is evident, then, that this area exercises more influence in determining the amount of front-end draft required than does the area of the openings through which the air enters the firebox. But this does not mean that overcoming resistance of the passage of air into the firebox requires no additional power.

Would not the ideal solution for the restriction of the volume of air admitted to the firebox be a reduction in the front-end draft, with a consequent improvement in the indicator card and in the steam consumption? There can be no question but that the round-hole grate is practicable, but is it necessarily the most efficient means by which the desirable objectives set forth by Mr. Roesch may be obtained? This is a question requiring more complete test data than is available today.

NEW BOOKS

MASTER CAR BUILDERS' AND SUPERVISORS' PROCEEDINGS. *Arranged and edited by Secretary-Treasurer A. S. Sternberg, master car builder, Belt Railway of Chicago, 7942 South Morgan street, Chicago. Bound in cloth, 248 pages, 5½ in. by 9 in.*

This book, containing the proceedings of the joint convention of the Railway Car Department Officers' Association and the Southwest Master Car Builders' and Supervisors' Association at the Hotel Statler, St. Louis, Mo., September 11 to 13 inclusive, 1928, will be of interest to every car-department supervisory officer. It contains an account of the consolidation of two independent associations into what promises to become the largest and most influential body of strictly car-department officers in the country. In addition to outlining the arguments pro and con regarding consolidation and the action making it effective, as well as the new constitution, the book contains addresses by Henry Miller, president of the Terminal Railway Association of St. Louis, and R. C. White, assistant general manager of the Missouri Pacific, also papers on handling of explosives by R. H. Innes, inspector, Bureau of Explosives, Dallas, Tex.; higher maintenance of freight equipment, by L. R. Wink, superintendent of the car department of the Chicago & North Western; freight claim prevention, by Joe Marshall, special representative, American Railway Association; elimination of angle cocks by J. P. Stewart, general supervisor of air brakes, Missouri Pacific; efficiency of car shop operation, by H. J. Huff, efficiency supervisor Chicago & Eastern Illinois, and testing of car materials, by J. R. Jackson, engineer of tests of the Missouri Pacific. Committee reports are included on the elimination of grease spots and on the A. R. A. rules of loading and interchange.

PROCEEDINGS OF THE THIRTY-SIXTH ANNUAL CONVENTION. *344 pages, 6 in. by 8½ in. Published by the Air Brake Association, T. L. Burton, secretary, 5605 Grand Central Terminal, New York.*

The complete papers and reports presented before the Air Brake Association at Chicago April 30 to May 3, inclusive, 1929, are printed in the proceedings of the thirty-sixth annual convention of the association. The papers discuss the best material for air brake and air signal piping; distributing valves, location, maintenance and piping; automatic speed control and automatic train stop equipment; slid flat wheels in passenger train service, causes and remedies; operation and maintenance of engineer's brake valves; gas- electric rail-car brakes; exclusion of dirt and moisture from passenger-car brake cylinders; maintenance of brake equipment on gas rail cars; car retarders; recommended practice, and main reservoirs. The contents of the convention proceedings of the association from 1894 to 1929 are also indexed in this volume.

MATHEMATICAL TABLES AND FORMULAS. *By Percey F. Smith, Ph.D., and William Raymond Longley, Ph.D., professors of mathematics, Yale University. 66 pages, 5 in. by 8 in., thumb indexed. Published by John Wiley & Sons, Inc., New York. Price $1.60.*

This is a handbook for students in mathematics, or workers in any field requiring applications of calculus. Numerical problem work being essential for an understanding of mathematic theory, the results in the tables, which have been found by experience to be most useful in solving the problems which arise in connection with college courses in trigonometry, analytic geometry, calculus and mechanics, are reduced to numbers of three or four significant figures. The collection of formulas is intended to save time and relieve the burden on the memory, without reducing problem work to mere substitution of numbers in equations.

LOCOMOTIVE ENGINEERS' POCKET BOOK. *Published by The Locomotive Publishing Company, Ltd., London, England. 378 pages, 6½ in. by 4½ in.*

The 1929 edition of the Locomotive Engineers' Pocket Book contains nineteen chapters. The first chapter is a specification of the conditions under which a locomotive has to do its work and the nature of the work which it has to do. The succeeding chapters discuss the resistances of trains; boiler power, engine power and adhesion; wheel arrangements; weight and weight distribution; stability on curves; laminated bearing springs; valve gears; locomotive performances; dimensions of locomotives; steam and Diesel locomotives; electric, condensing and turbine locomotives, etc. The selection of shop sites and the arrangement of new buildings are discussed in detail in a chapter on locomotive shops. The appendix contains tables giving the properties of saturated and superheated steam; heating surface of tubes; British and metric measures, etc.

THE READER'S PAGE

How Do You Lubricate Your Floating Bushings?

CHICAGO.

TO THE EDITOR:

Practically all railroads are to some extent applying floating bushings in main and middle-connection side rods in which holes are drilled various distances apart and of as various diameters for the purpose of lubrication. Has any reader of the *Railway Mechanical Engineer* had any experience with grooving these bushings on both internal and external diameters instead of drilling as many as 65 ¼-in. holes in them?

If so, will they let us have the results obtained, also describe the machine or method of grooving employed.

I believe consideration should be given to finding a better and more economic method of lubricating these bushings than by drilling them full of holes with a single-spindle drill. So far I have not discovered any shop making use of a multiple drill head for this operation. If there are any, I should be interested in seeing a description of their methods. SUPERVISOR.

Arbitration Case 1613 Incorrectly Summarized

CHICAGO.

TO THE EDITOR:

Please refer to the January issue of the *Railway Mechanical Engineer*, page 36, Arbitration Case No. 1613. Your report of this case is misleading to any one who failed to read the original report carefully and in detail.

Your summary of this case, states that the cars were buckled and derailed, and then gives the committee's decision as an owner's responsibility. The statement of facts in the original case as referred to the Arbitration Committee, shows that the first report was in error, and that after a full investigation a report was submitted stating that the cars were not derailed and that no part of the cars had touched the ground. I believe it was this on which the decision is based.

It is my recommendation to clear this matter up with your readers, that you reprint Arbitration Case No. 1613, in its entirety with notes explaining how this error occurred.

GENERAL CAR FOREMAN.

[While it does not seem necessary to publish the case in its entirety, we are glad to reprint a corrected summary which appears under the heading Decisions of Arbitration Cases.—EDITOR.]

Roads Must Make Their Mechanics

OMAHA, NEB.

TO THE EDITOR:

The letter from R. R. Howarth, which appeared on The Readers' Page of your January issue, reflects a problem that is troubling railroad mechanical officers as well as thoughful apprentices.

The modernization of railroad shops and shop methods has brought about changes which render many old methods obsolete. Among these may be mentioned the traditional method of apprentice training. Where apprentice training has been modernized, so that it is keeping pace with modern shop requirements, there is no doubt in the minds of mechanical officers or apprentices as to the value of a system of apprenticeship and apprentice training. The fundamental factors have not changed, but new methods are required to keep apprentice training in step with changing shop conditions.

The question as to whether the usual one-to-five apprentice ratio is proper has been given serious consideration by many railroad mechanical officers. Suggestions have been made that this ratio should be made one-to-ten; whereas, there are roads which maintain a ratio of one-to-three. During that period when shop forces were being reduced because of the working out of modernization programs, all established ratios appeared to be out of balance. Today we are re-entering a period of stabilized employment in our shops; consequently, we must consider fundamentals in determining the proper apprentice ratio.

Ordinary mortality statistics which are prepared by insurance companies indicate a labor turn-over of from three to five per cent a year from natural causes alone. Under stabilized conditions a shop employing a thousand mechanics will have a labor turn-over from natural causes of from 30 to 50 mechanics a year. On the one-to-five apprentice ratio, there would be 200 apprentices in this shop, in addition to the 1,000 mechanics. One hundred of these would be regular apprentices serving four years, another 100 helper apprentices serving three years. Taking three-and-one-half years as the average period of apprenticeship and dividing 200 by 3½, gives approximately 30 graduate apprentices per year—just about enough to supply vacancies in the ranks of the mechanics. This does not allow for any labor turn-over in the ranks of apprentices; whereas, it is well known that the turn-over is higher among the apprentices than among the mechanics. Fundamentally, the one-to-five apprentice ratio is quite reasonable under normal conditions.

In large industrial plants, where manufacturing is on a highly specialized production basis, there is a tendency, as far as possible, to adapt methods and machines to automatic processes. Nevertheless, in the most highly specialized shops skilled craftsmen are required to set up, adjust and repair machines. In our railroad shops where we are maintaining and repairing, instead of manufacturing—it will be many years before processes can be devised to eliminate the human element to any considerable extent. There is greater need for skilled mechanics in railroad shops than in large industrial plants. This is particularly true at the smaller shop points and in roundhouses.

There are a number of large railroad shops in the country where a great deal of work is highly specialized. but there still is, and for years to come there will continue to be, a demand for skilled railroad mechanics.

While railroad-trained mechanics can quickly adjust themselves to work in almost any industry, it is difficult for a mechanic unfamiliar with railroad work to adjust himself to railroad shop conditions; consequently, the railroads must train their own mechanics if they expect to develop workmen which will be as modern as our present railroad shop plants and methods.

Under modernized apprentice training methods ap-

prentices develop an efficiency which justifies a foreman in making special efforts to carry out a proper shop schedule to give the apprentice practical experience comparable to the effectiveness of his training in the technique of his work. On the other hand, where apprentices are not under proper discipline, where they are not being trained properly in the technique of their work, and where they are not looked upon as a necessary element in the proper development of modernized shop routine, it is hardly reasonable to expect that the shop foreman held to rigid production schedules will pay much attention to the shop training of apprentices.

There is nothing wrong with the fundamental idea of apprentice training. There is no industry today where under proper conditions an apprentice can gain better shop experience than on a railroad. There are a number of railroads, where modernized apprentice training is in effect, that are developing graduate apprentices who are so efficient that these railroads make special efforts to find places to use them, even though they might not be absorbed in the ordinary routine.

Railroad apprenticeship today is more important than ever before. Its importance demands that the same careful thought be given to apprentice training methods as has been so successfully applied to the modernization of many other phases of our railroad shop activities.

DEXTER C. BUELL.

Draft-Gear Maintenance

NEW HAVEN, CONN.

TO THE EDITOR:

In the December, 1929 issue of the *Railway Mechanical Engineer,* in an article written by J. P. O'Connor, I was somewhat surprised to read that there are some draft gears equipped to take up slack after slight wear which should be good for eight or ten years service without being removed for an inspection.

I am highly in accord with Mr. O'Connor in respect to making a periodical inspection of draft gears. But I hardly agree with him that some or any draft gears will stand eight, ten or even five years service without an inspection. Of course, there are exceptions to all rules and there are some extraordinary cases, but no practice can be founded on such conditions. A conservative time period for making such inspections should be from 18 to 24 months, the former time for modern draft gears and the latter for the old style gears.

As to the condition of the draft gear which is applied at time of renewal, a new gear or a gear that has been completely overhauled and tested to the minimum requirements of the class of gear standard to the car, is perfectly all right in my opinion regardless of whether or not new or second hand parts have been used.

Mr. O'Connor makes reference to cars equipped with obsolete draft gears. It is true that some cars have gears that are obsolete in modern freight cars. But if the car owner chooses to maintain these gears, it is a problem for the car owner and not the repairing line to solve. One large railroad in this country is using an improved pioneer friction draft gear. I will dare say that the annual cost for a car per year for draft-gear maintenance on this railroad would be equal to the cost of one modern friction draft gear. Mr. O'Connor suggested that the repairing line should be permitted to apply a modern draft gear to such cars and change the stencil on the car. In other words, the repairing line shall use its own judgment as to what will constitute a modern draft gear for a specified car. This is a good idea in one sense only. It gives the car a modern draft gear. On the other hand, it would make it almost impossible for a car owner to maintain a standard draft gear on its equipment if this procedure was allowed.

The draft arrangement should be so designed that the gear can be inspected at all times without being removed from the car. This factor in itself is a great asset to the proper maintenance of draft gears. But the correct way to inspect draft gears periodically is to remove them from the car. Have them tested at a shop and, when they are repaired or pronounced O.K., returned to the repair points for reapplication.

One thing that can be done to improve the draft gear situation is to design cars when rebuilt to meet the A.R.A. tentative specifications for freight-car draft gears, if this is not possible the A.R.A. pocket should at least be applied. This will allow the foreign roads, when replacing defective gears, a chance to apply draft gears that will meet the requirements of modern draft gears.

Why do we have a periodical inspection of air brakes and, journal bearings? If you were asked to allow air brakes to run indefinitely until they failed to function, you would say that such a procedure was impossible. Is not a draft gear as important an item as an air brake? These two parts of a car work in conjunction with one another and both should receive equal attention. Let us hope that this year will be the turning point in draft gear maintenance and that the A.R.A. will place a mandatory rule in the interchange code for the periodical inspection of draft gears.

J. W. MCDONNELL.

Why Joint Research Is Desirable

OMAHA, NEB.

TO THE EDITOR:

I note the editorial in the January *Railway Mechanical Engineer* which takes exception to my recommendation for a research laboratory controlled by the American Railway Association. Apparently the writer of this editorial has an entirely different conception from my own of what constitutes research.

In my statement I referred not only to problems regarding steel but to a number of other material problems which have been giving the railways much trouble and have been very expensive. In solving some of these problems, as much of the research work is done outside the laboratory as in it. It is necessary to have a thorough understanding of the conditions under which the material is used and to know the troubles that come from service conditions. It is equally important to gain as much knowledge as possible concerning the manufacture of the material, and then co-ordinate this with the laboratory research.

Our experience has been that it is very difficult to get any group of manufacturers to work out problems of this type together and it is because I believe that a central organization, controlled by the railroads, can develop this work more to the interest of the railroads than will be done by the manufacturers, that I made the suggestion. I want to say that I have had the finest co-operation from the manufacturers in every problem that I have undertaken, but that many of us working in the railroad laboratories are burdened with an excessive amount of routine work so that the research problems are very slow in developing.

WM. M. BARR,
Consulting Chemist, Union Pacific System

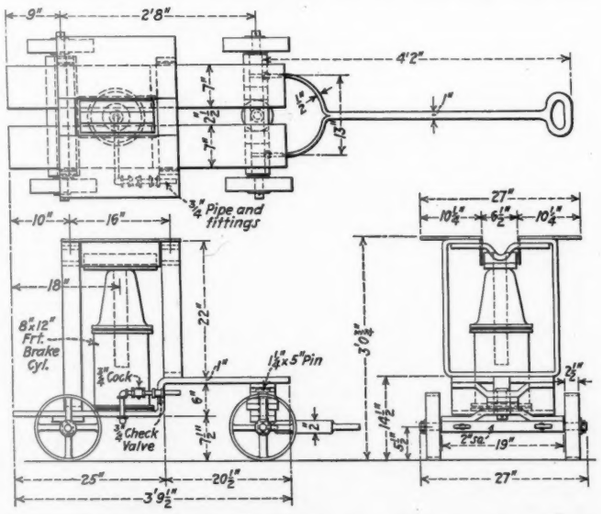
With the
Car Foremen and Inspectors

Car Shop Tools *

AN investigation by the standing committee on tools and equipment for car shops and yards indicates that car-repair costs have been reduced extensively on the railroads in the past several years largely by the use of better tools. The efficiency of the tool-room employee in properly maintaining and supplying the tools also plays an important part in reducing this cost. The care of pneumatic tools has been provided for on a great many railroads by repairing them at one system point which, in itself, effects a saving in spare part expense. The different work that can be done on a bulldozer should not be overlooked.

The old type blacksmith shop where everything was hammered is gradually giving way to the modern shop equipped for turning out machine forgings which are much neater looking and, contrary to the belief of some conservative blacksmiths, much better forgings. With a few changes in clamping methods on bulldozers, a great number of forgings can be stamped, such as truck hangers, safety-chain devices and wrenches ordinarily used around the car yard and shop, and a number of other forgings which are now being made by hand.

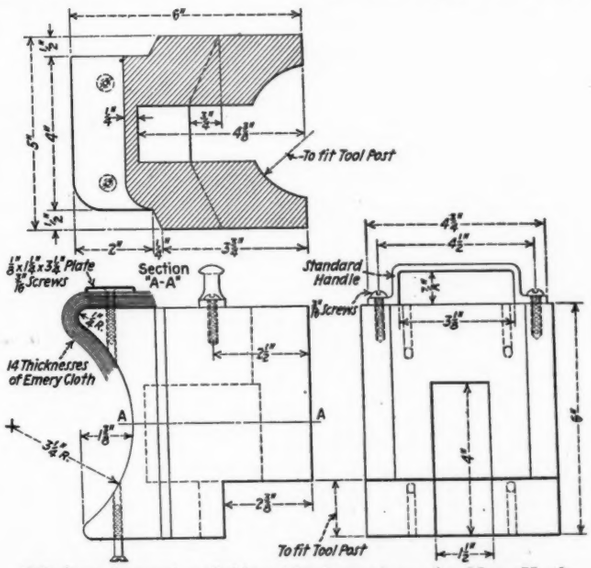
Another important phase of the car shop, with which



Portable air hoist for applying draft gears at Collinwood shops of the New York Central

the tool foreman should familiarize himself, is the selection of drills. Not only should he consider the length of the drills which will be required, but he should see that they will hold a cutting edge like high-speed material and still retain the toughness of carbon drills. The tolerances on foundation brake gear are being constantly reduced and, to meet this condition, all brake-connection pins, truck-lever pins and brake-hanger pins are turned and casehardened and all levers and rods are bushed. For shops not equipped with turret lathes, a problem of turning these pins cheaply after forging presents itself.

Many small inexpensive attachments on electric and pneumatic drills and boring machines are in use for driving screws, cutting threads, nut-running, etc., which speed up operations and cut down costs considerably on car repair work. The most commonly used tools on car-repair work are cold chisels. It is important that chisels be made of a good grade of steel and that proper care be exercised in the fabricating and heat-treating. Many chisels are now being made of semi-high-speed steel and



Efficient journal polishing block used on the New York Central

the service obtained is worth the additional cost of this steel over common tool steel.

The near future will also introduce high-frequency tools for car-repair work on many railroads, which will result in savings in labor as well as drills and reamer bits as compared with pneumatic tools. In a recent test it was found that drills and reamer bits used in high-frequency tools give longer service and cause less breakage. This is due to the steady and uniform pull obtained in the electric tools. The electric-power cost is also materially lower than the cost of compressed air in penumatic tools.

Since the wooden passenger car is a thing of the past and nearly all freight cars are either all-steel or composite, the railroads which hope to repair this class of equipment economically must buy modern machinery in order to enable them to do so. The tooling of this machinery is generally left to the judgment of the tool foreman who should in turn familiarize himself with the necessary dimensions on steel car bodies to design and make dies for these machines that will be required and also see that they are the proper size; that is, that they shall not be too heavy or too light. While most railroads have their own standards of appearance on car bodies,

*Abstract of committee report presented at 1929 convention of the American Railway Tool Foremen's Association.

a considerable saving could be accomplished if tool standards could be effected to take care of repairs to foreign cars. While the appearance of the riveting on freight cars is of secondary importance, a passenger car should present a neat finish and this can be secured by properly-made rivet snaps; for instance, using a rivet snap in the holding-on tool with an air connection all the way through it. This blows all the scale away from the rivet head and has a tendency to polish it as it cools. On wooden equipment that is being reinforced with steel underframes a good place for the pneumatic holder-on is afforded. The manufacturers are not yet making these small enough to do this class of work with the result that it is necessary for the railroads to make their own.

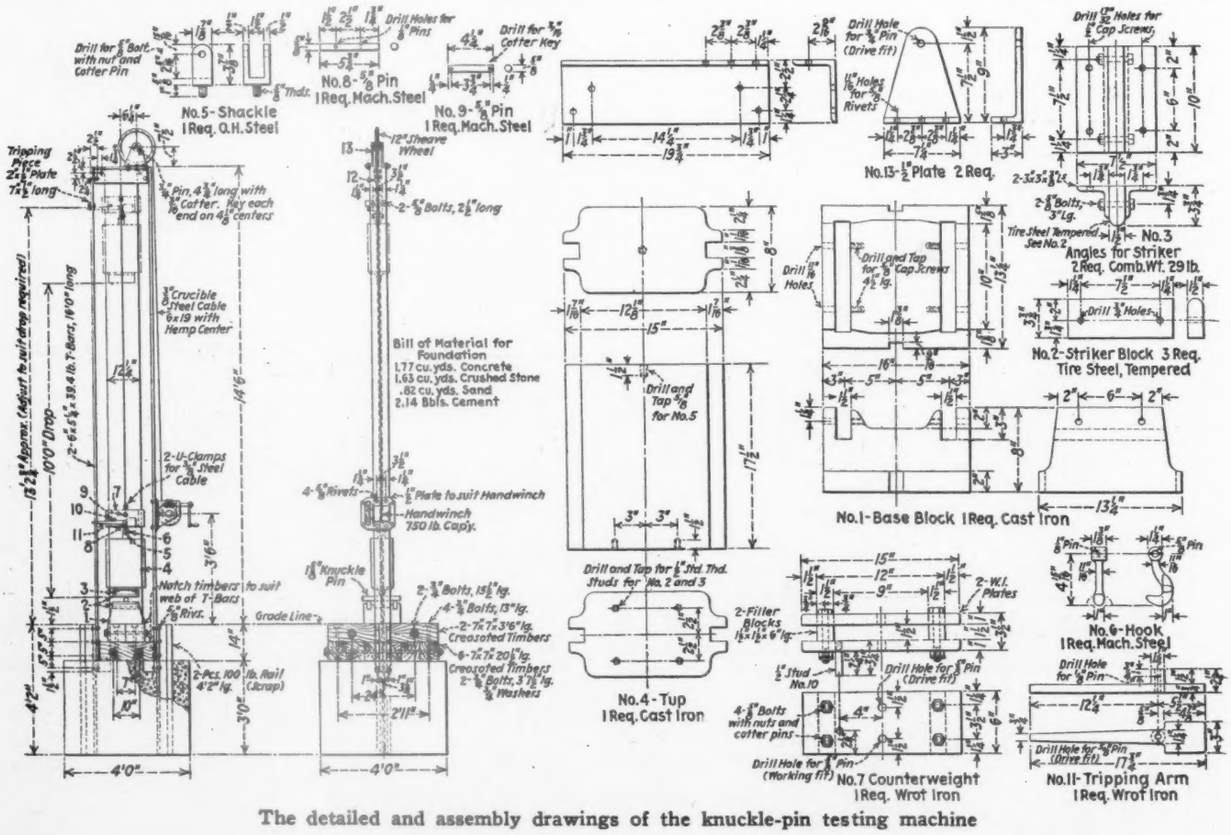
Another phase of the car shop that has been overlooked by the tool foreman is the cut journal evil and the expense that results therefrom. The tools necessary to turn a smooth journal should, without a doubt, be taken care of by some one who is thoroughly experienced with the grinding of tools and, as these tools are made with radius to conform to A. R. A. standards, they should be gaged while being ground. Care should also be exercised in the grinding of boring-mill cutters as to length and width of cutting edge and this cannot be done accurately by hand. The A. R. A. has also ruled that all car brasses shall either be broached or bored before application. Jigs for holding the different size brasses can be made for use on a shaper, and cutters graduated in tenths of an inch from maximum to condemning limits. This method will be found much more economical than boring, and, with ordinary care on the part of the operator on the machine, these cutters will last a long time without sharpening.

The illustrations show an efficient journal polishing block for use on journal lathes and an air hoist for applying draft gears which is simple in design, safe and a great labor saver. These devices have been used at the New York Central car department at Collinwood, Ohio, and found satisfactory.

The report was signed by Chairman E. S. Behen, tool foreman, Missouri-Kansas-Texas, Sedalia, Mo.; G. Reichart, superintendent of freight shops, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis., and J. T. Jones, tool foreman, New York Central, Collinwood, Ohio.

A Drop-Test Machine for Knuckle Pins

A DROP test machine which has rendered very satisfactory service in the testing of knuckle pins is shown in the following detailed and assembly drawing of the device. The machine consists of a 470-lb. weight and striker which is raised by a winch to a height of 10 ft. From here it is automatically tripped, causing it to descend on a knuckle pin which rests on a cast iron base block. In the concrete foundation, 4 ft. square and 3 ft. high, are imbedded two sections of 100-lb. rail, 4 ft. 2 in. long to which are riveted the two 6-in. by 5¼-in. by 16-ft. T-bars which form the upright standards of the machine. A 12-in. sheave wheel is mounted on the plates riveted to the top of the standards. The cast-iron base block is set on two layers of creosated wooden blocks that are well bolted together and secured to the foundation by anchor studs. To the drop weight, shown as piece No. 4 in the drawing, is attached the


No.5-Shackle 1 Req. O.H. Steel
No.8-⅝" Pin 1 Req. Mach. Steel
No.9-⅝" Pin 1 Req. Mach. Steel
12" Sheave Wheel
Bill of Material for Foundation
1.77 cu. yds. Concrete
1.65 cu. yds. Crushed Stone
.82 cu. yds. Sand
2.14 Bbls. Cement
No.13-½ Plate 2 Req.
No.3 Angles for Striker 2 Req. Comb. Wt. 29 lb.
No.2-Striker Block 3 Req. Tire Steel, Tempered
No.1-Base Block 1 Req. Cast Iron
No.4-Tup 1 Req. Cast Iron
No.6-Hook 1 Req. Mach. Steel
No.7 Counterweight 1 Req. Wrot Iron
No.11-Tripping Arm 1 Req. Wrot Iron
Grade Line
4'0"
4'0"

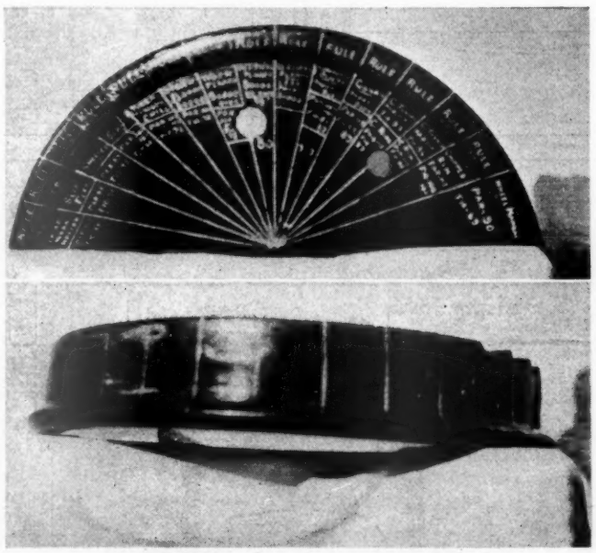
The detailed and assembly drawings of the knuckle-pin testing machine

striker which consists of two $2\frac{9}{16}$-in. by 6-in. by 19¾-in. angles and a section of tempered tire steel, 1½-in. thick, 3¼-in. wide and 7½-in. long. The top of the drop weight is fitted with connections for a trip-lever attachment and a wrought-iron counter-weight which in turn is securely clamped to the cable which elevates the entire dropping mechanism and weights. These parts are raised by means of the winch located on one of the uprights, 3½ ft. above the grade line, and are guided by the channel sections of the drop-weight which fit the stems of the T-section uprights. When they are raised to the position shown by the dotted lines in the assembly drawing the tripping arm strikes the 2½-in. by 7½-in. tripping plate, thus releasing the drop-weight and striker to fall on the knuckle pin which rests on the base block. As shown in the side elevation of the device and in piece No. 1 of the detailed drawing, the base block is channeled and fitted with two sections of tempered tire steel. The knuckle pin to be tested is suspended across these two sections and is struck by the falling weight and attached striker tending to break or bend it. The device is easily constructed at a compartively low cost and it affords a quick and reliable means of testing knuckle pins.

Visual Method for Explaining Wheel Defects

By M. P. Cole

THERE is no reason why a railroad officer or apprentice instructor cannot utilize the methods known to be successful in modern educational work in the instruction of classes in railroad operation and equipment maintenance. For example, it is considered to be much easier to reach the mind of the average



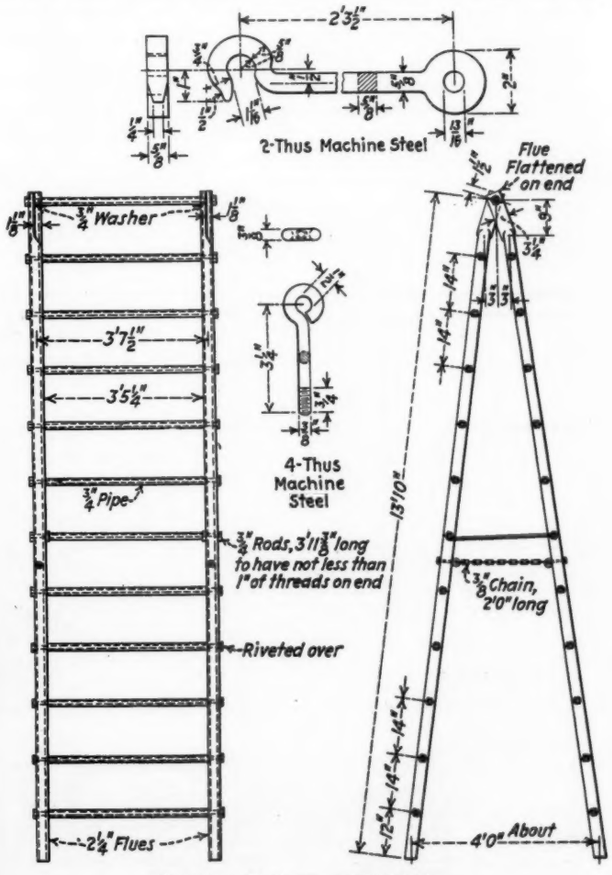
Top: Side view of the wheel model showing the references to the A. R. A. rules—Bottom: Actual defects are reproduced on the tread and flange

student through the eye than through the ear. Therefore, this idea was followed in the instruction of classes in wheel defects on the Boston & Maine.

Referring to the illustration, a half-section of a car wheel was made showing slid-flat spots, chipped rims, worn flanges, and other wheel defects covered in the A.R.A. rules. Standard A.R.A. wheel gages can be applied to this model, as they are used for gaging wheels in actual practice. Each defect is marked off by radial lines and the number of the rule and section covering the defect is lettered in the segment formed by the adjacent lines. This model, which can be made in any pattern shop, has proven to be of value in the instruction of classes, and at educational meetings of car-department foremen and men.

A Scaffold Ladder

AN eastern railroad has adopted scaffolding ladders of the design shown in the detailed drawing, as standard equipment and has distributed them for use in tank shops, boiler shops and car shops. The ladder consists of four sections of 2¼-in. flues, flattened and bent at one end in the manner shown and bolted together by



Details of the scaffold ladder

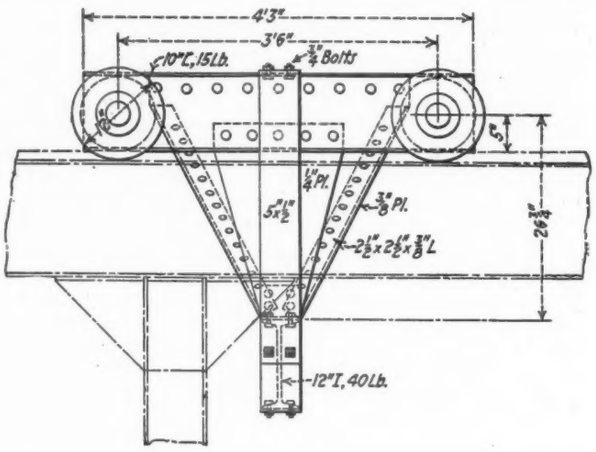
means of one of the standard rung bolts. The rungs are made of ¾-in. pipe and are secured between the side rails by long ¾-in. bars of round stock, which pass through the rungs. These bars are threaded at each end, bolted securely in position and riveted at the ends to prevent loosening of the nuts. There are 11 rungs on each section of the ladder, spaced 14 in. apart. The total height of the ladder is 13 ft. 10 in. and it has a spread of approximately 4 ft. A ⅜-in. chain, 2 ft. long is placed midway up the ladder, to limit the spread of the two sections. A hook latch is bolted to one section and latched to a rung of the other section.

Cranes and Scaffolding for Car Repairs

SEVERAL years ago an eastern railroad decided to handle freight-car repairs in one of its principal shops by the progressive system. Because the cars receive anything from light repairs to a complete rebuilding without being moved from their stations after once being spotted, it was considered advisable to provide each station with complete facilities for handling both scrap and new material. The shop building was 80 ft. wide. It was provided with two pit tracks, which extended the entire length of the building. The shop was served by a 10-ton overhead electric traveling crane with a clearance of 23 ft. from the lowest portion of the crane to the floor.

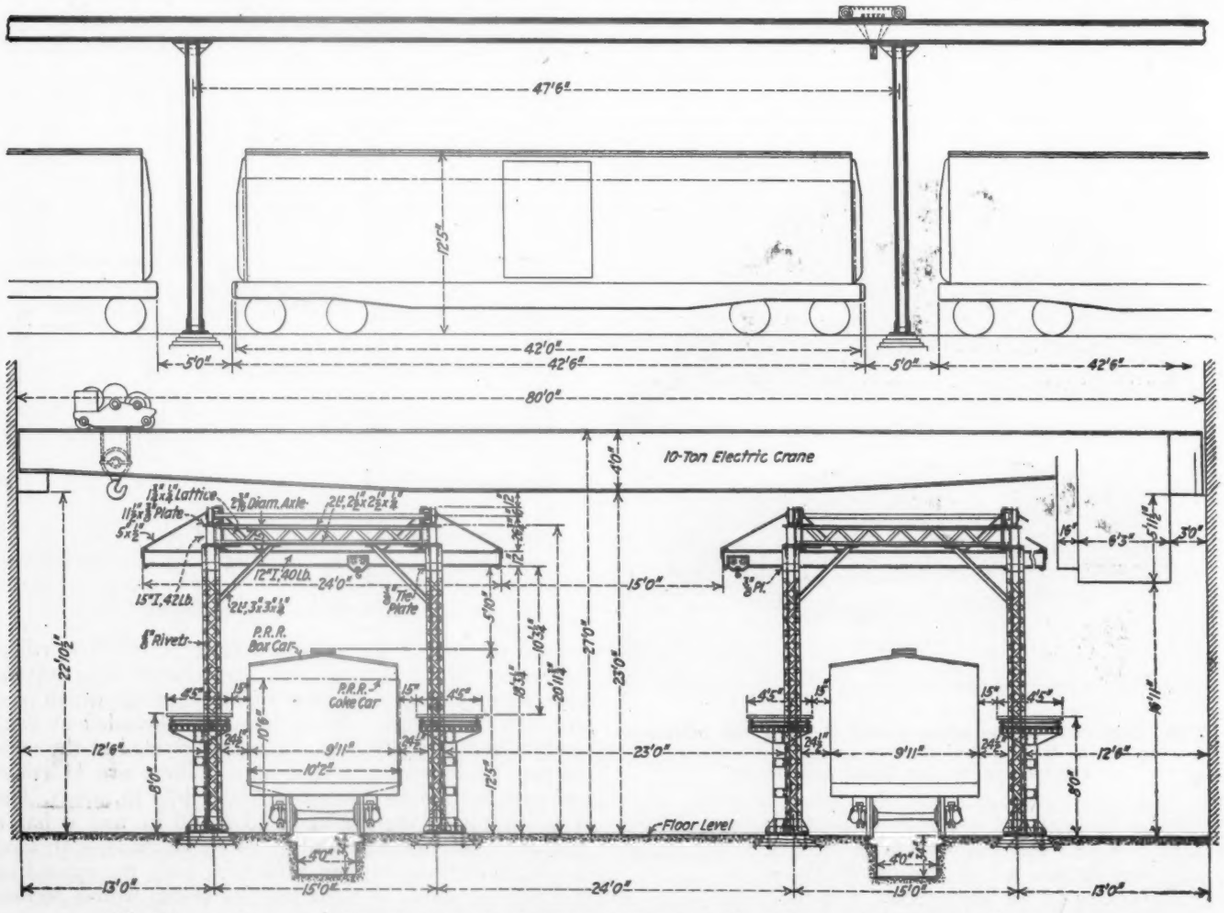
The detailed construction of the material-handling facilities provided at each station is shown in one of the drawings. In addition, details of the hand-operated overhead traveling crane and the end-trucks or carriage are shown. Considerable of the material used in the construction of the scaffolding and crane supports is from scrap reclaimed from steel open-top cars.

The end-trucks of the hand-operated crane run on a track which extends the entire length of the shop. The track rests on columns made of two 8-in. 11-¼ lb. channels fastened together with 1¾-in. by 5/16-in. lattice bars. Each column rests on a concrete base, and is 19 ft. 8-¾ in. long. The rails are carried on two 15-in. 42-lb. I-beams, as shown in the elevation and cross-section drawing. Each pair of columns is spaced 47 ft. 6 in. apart, center to center, which provides a working space at each station along the track of approximately 43 ft. Clearances were estimated for a total height from the rail of 12 ft. 5 in. and an outside width of 10 ft. 2 in.



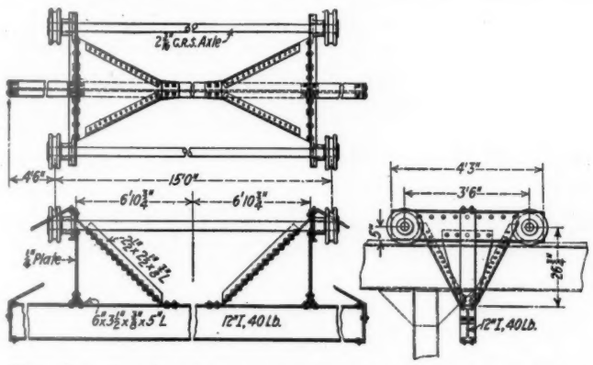
Details of the end carriage of the hand-operated crane

Each station is provided with one hand-operated traveling crane. Owing to the fact that the crane bridge is suspended below the crane tracks and that its ends



Elevation and cross section showing the facilities and material-handling equipment at each repair station

extend beyond the column line, the cranes can only be operated over their respective station areas. Although this feature appears to be a disadvantage on first consideration, it posseses certain advantages, inasmuch as workmen at adjoining stations cannot borrow cranes from their neighbors. This eliminates the possibility of one station having two or three cranes, while others have



Drawing showing the construction of the hand-operated traveling crane

none. It will be noted that the crane bridge extends beyond the outer edge of the permanent scaffolding along each side of the repair track. With this arrangement, the crane can be used for hoisting material from the floor to any desired location on the scaffolding or car.

The scaffolding is 4 ft. 5 in. wide, the inside edge being 15 in. from the side of the car. The flooring, which is made of 2-in. planking, rests on substantial supports made of scrap side sills which stand on a concrete base. With the exception of the wheels for the crane end-trucks and trolleys and a few minor details, the entire arrangement is made of structural steel and scrap plates, channels and angles from open-top cars. The wheels for the crane end-trucks are of cast iron, double flanged, 10 in. in diameter. They have a 2-in. tread and the flanges are 1 in. high by ¾ in. thick. The crane trolleys, which are carried on rollers, are also of cast iron, machined so as to freely roll close to the web of a 10-in., 15-lb. channel. The trolley rail is made of two of these channels placed back to back.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Arbitration Case No. 1613—A Correction

[A letter appears on the Readers' Page of this issue calling our attention to the fact that the summary of Arbitration Case No. 1613 which appeared in the January issue, page 36, was incomplete and that the portion of the statement on which the Arbitration Committee had apparently based its decision had been omitted. The report of the case is reprinted herewith together with that portion of the facts which was omitted last month, printed in italics.—EDITOR.]

On December 30, 1927, two cars of a Boston & Maine freight train were *reported as being* derailed and buckled together near Greylock, Mass. This train consisted of 44 loads and 22 empties, a total of 2,535 tons. An air hose burst on Quebec Central car No. 2422 while the train was passing Blackinton station, near Greylock, at a speed of 20 m.p.h. This car was the thirteenth car from the rear end of the train. The application of the brakes pulled out the draw bar on one end of Boston & Maine car No. 63478, the draft timbers of which were in a defective condition. This car was the fifth car in the train from the locomotive. The sudden stop of the train caused two empty Quebec Central cars Nos. 1525 and 1909, which were of wooden construction, to buckle. All of the sills of both cars were broken. *The report of the wreck master and also further investigation by the mechanical superintendent, Boston & Maine, showed that the first reports were wrong in stating that these two cars were derailed, as it was found that no wheels of any car had been derailed and that no part of either of the damaged cars had touched the ground. The Quebec Central was notified of the results of the further investigation and was requested to furnish disposition of the two cars. The owner, however, refused to furnish disposition requested within the 30 days allowed by the rules and the handling line destroyed the cars.* The Boston & Maine claimed that the failure of the Q. C. cars was due to their weak construction and age. The Quebec Central maintained that the direct cause of the damage was the pulling out of the draw bar on the Boston & Maine car and not the bursting of the air hose.

The Arbitration Committee, in rendering its decision stated that "Investigation developed that the cars were not damaged under any of the conditions of Rule 32. Car owner is responsible."—*Case No. 1613—Boston & Maine vs. Quebec Central.*

Arbitration Case No. 1613—A Correction for Cast-Iron Box

K.C.S. car 15475 was repaired by the C.C.C. & St. L. on November 8, 1927, by applying a 5-in. by 9-in. malleable-iron journal box in place of a cast-iron journal box which had been broken in a derailment. A net charge of $3.29 was made by the Big Four. The Kansas City Southern objected to this net charge, claiming that the repairs did not constitute a betterment. The Big Four contended that Rule 17, section b, authorized the substitution of malleable-iron A.R.A. standards for grey-iron standards, and that the charges made and credit allowed were in accordance with Rule 101. It declined to cancel the charge.

In deciding this case the Arbitration Committee stated that "The bill of the Cleveland, Cincinnati, Chicago & St. Louis is not sustained to such a case, on the basis of Rule 17, section b. Where the repairs are due to delivering line's defects, the charge for the increased cost is not permissible, except on authority of a defect card when repairs are made by other than the car owner."—*Case No. 1616—Kansas City Southern vs. Cleveland, Cincinnati, Chicago & St. Louis.*

Charge and Credit for Exchange of Couplers in Correcting Wrong Repairs

On June 23, 1929, the Missouri Pacific repaired Union Refrigerator Transit Company's car No. 40352 at Hoisington, Kans., applying at the B end of the car a temporary standard coupler in place of the A.R.A.

standard Type D coupler, attaching a defect card to the car to cover the wrong repairs. The Union Refrigerator Transit Company, in correcting the wrong repairs, applied a new A.R.A. Type D coupler and rendered a bill for the A.R.A. value, contending that the A.R.A. rules should, and do, protect car owners against the use of non-standards or former standards to replace defective or missing A.R.A. standards, and that the provisions of A. R. A. Rule 87 are applicable in all such cases without exception, other than those noted in the rule, itself. The handling line stated that the owner rendered a charge for the correction of improper repairs to this car amounting to $70.27, and contended that in correcting the improper repairs, the charge should have been rendered on the basis prescribed in paragraph (d) of Rule 17; that is, a charge for one secondhand 6-in. by 8-in. Type D coupler, $18.56, and credit allowed for one secondhand 5-in. by 7-in. temporary standard coupler, $16.39, a differential of $2.17, which is all that should have been charged.

The decision rendered by the Arbitration Committee was as follows: "Rule 17, Paragraph (d), applies. Charge and credit for couplers exchanged by the Union Refrigerator Transit Company in correcting the wrong repairs should be at secondhand values. The position of the Missouri Pacific is sustained."—*Case No. 1617—Union Refrigerator Transit vs. Missouri Pacific.*

Placing Responsibility for Wrong Repairs

On December 20, 1927, the T. I. D. X. tank car 1225, the property of the Tidal Refining Company, was moved out of the owner's shops at Drumright, Okla. The following day it was repaired at Arkansas City, Kans., by the Santa Fe which line applied a 64-in. coupler yoke, two coupler-yoke rivets, four carrier-iron bolts and seven tie-strap bolts at the A end of the car, repairs being made on account of old parts broken or worn out. On December 24 the Terminal Railroad Association of St. Louis applied one coupler, four carrier-iron and four tie-strap bolts to the B end of the car. When the car was returned to the owner's plant on January 18, 1928, a joint evidence card was secured by the owner which reads as follows: Four coupler straps and four back carrier-iron bolts—should be rivets; one coupler, 5 by 5 by 9⅛—should be Type D, 5 by 7 by 9⅛; one coupler yoke, 1¼ by 5 by 64, without lugs—should be 1¼ by 5 by 62 with lugs—B end. The owner then submitted the joint evidence card to the Terminal Railroad Association and demanded a defect card for repairs made at the B end of the car. The Terminal Railroad Association called particular attention to the Santa Fe repair card, as the joint evidence card issued on January 18, 1928, takes exception to the 64-in. coupler yoke at the B end of the car and makes no mention of such a condition at the A end. While the car was in the Terminal Railroad Association shops at Madison, Ill., inspectors showed that the carrier-iron and coupler-strap bolts were standard at both ends of the car, confirming information furnished by the Santa Fe which stated that the repairs made by the Santa Fe were in accordance with the standards of car T. I. D. X. 1225 at that time, December 21, 1927. The Terminal Railroad Association contended that since no repairs similar to those made by the Santa Fe, or by itself, were made by any other companies between December 20, 1927, and January 18, 1928, the car evidently came out of the Tidal Refining Company shops on December 20, 1927, carrying standards which on January 18, 1928, were claimed as wrong repairs. The Tidal Refining Company maintained that improper repairs were made to the A end of the car by the Santa Fe and to the B end of the car by the Terminal Railroad Association of St. Louis and that the improper conditions were found on the return of the car to its plant on January 18, 1928, and corrected there the following day. The joint evidence card, specified as being final in A. R. A. Rule 12, and the owner's original record covering the correction of improper standards, were submitted to the Committee.

The following decision was rendered by the Arbitration Committee: "The joint evidence is final. Claim of the Tidal Refining Company is sustained."—*Case No. 1618—Terminal Railroad of St. Louis vs. Tidal Refining Company.*

Responsibility for Damage Caused by Brake Application from the Automatic Train Control

On Nov. 2, 1927, A. S. D. car 853 was delivered to the North American Car Corporation in a wrecked condition, with draw bars and draft sills pulled out. Investigation developed that this car was damaged on the Nickel Plate on July 28, 1927, as a result of an emergency application of the brakes caused by the functioning of the automatic train control. The owner contended that the handling line was responsible for the damage in accordance with Rule 32, Paragraph 2 Section D. and advanced the assertion that the Nickel Plate should assume the responsibility because of the negligence of the engineman in failing to observe the signals, thus causing the automatic train control to function. The handling road maintained that no cars were derailed or otherwise damaged and that the stop made by the automatic train control was the same as a regular stop by service application of the air when made by the engineman and, therefore, the damage resulting to the car is the owner's responsibility.

In making the decision the Arbitration Committee stated: "Damage caused by the application of air brakes due to the functioning of automatic train control, does not constitute unfair usage under the provisions of Rule 32, except as otherwise provided therein. However, damage caused by sideswiping is the responsibility of the handling line."—*Case No. 1619—North American Car Corporation vs. New York, Chicago & St. Louis*

* * *

A rebuilt 4-4-0 type locomotive on the Delaware & Hudson at Colonie, N. Y.—Special pains were taken at the time of re-construction to improve the appearance by locating pipes and accessories in inconspicuous places and installing a "cap" stack

In the Back Shop and Enginehouse

A Way To Secure Loose Deck Plates

A LOOSE deck plate on a locomotive constitutes an I. C. C. defect. Anyone with engine-terminal experience knows what a difficult job it is to make permanent repairs to a "working" deck plate or other parts of a frame in the average enginehouse. The parts are, as a general rule, badly worn and do not bear evenly on the frame. Bolts and short keys or wedges frequently fail to hold the casting securely after a short

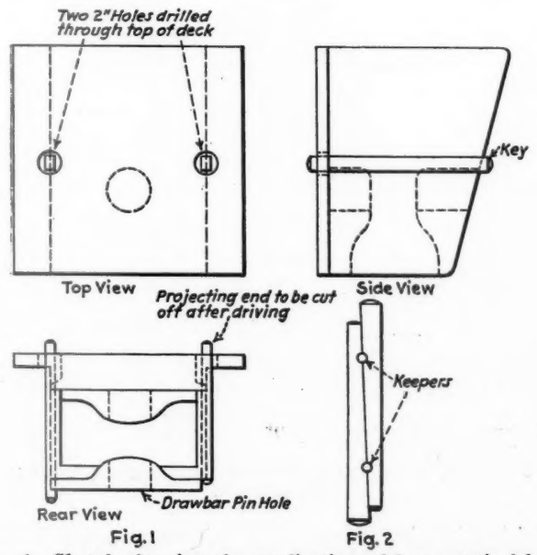


Fig. 1—Sketch showing the application of long vertical keys between the deck-plate casting and the frames; Fig. 2—Double key, often used for vertical frame splices, which can be used in this application

time in service. The casting may not be sufficiently thick to provide a long bearing surface for the bolts, and as a result it works loose and cuts into the bolts.

The key or wedge usually used for tightening the casting on the frames has somewhat the appearance of a main-rod shear key. A key of this type ordinarily has a bearing surface of not more than 4 in. to 6 in. through the frame and deck-plate casting.

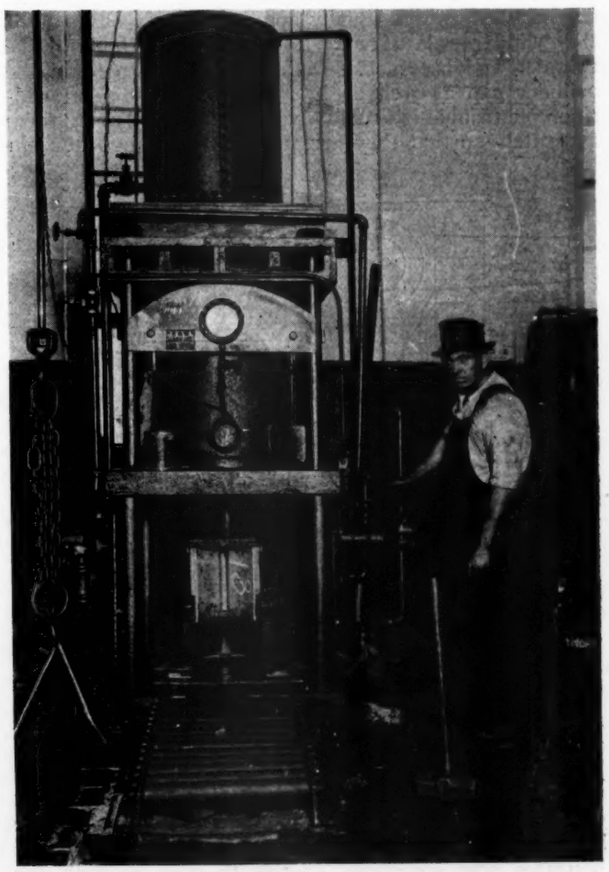
The design of deck plate key shown in Fig. 1 of the sketch was applied to an entire class of locomotives on a western road when the locomotives were rebuilt. Experience in service has shown the application to be an improvement over other arrangements. Each key extends vertically the full depth of the deck plate and has a bearing of approximately 12 in. in the frame. Two 2-in. holes are drilled through the top of the deck, as shown, through which the keys are driven. The arrangement of two taper keys in the same keyway, shown in Fig. 2 of the sketch, but driven from opposite directions, is also substantial. It is frequently used in vertical frame splices, and to assist in holding the low pressure cylinders in some designs of Mallet locomotives.

These keys receive considerable punishment, due to the fact that the draw bar pin passes through the deck plate. They should receive close attention at times of shopping or inspection.

A Press for Driving Box Crown Brasses

By J. H. Hahn

SHOWN in the illustration is a hydraulic press designed for removing and applying driving box crown brasses. This press has a self loading feature that saves considerable time. A freight-car air-brake cylinder is located at the rear of the press. The piston rod is connected to a plate on which the driving boxes are placed. One man can easily handle the driving boxes to the press by using the tongs and air operated



Boxes are moved in and out of this press by means of an auxiliary air-brake cylinder and piston

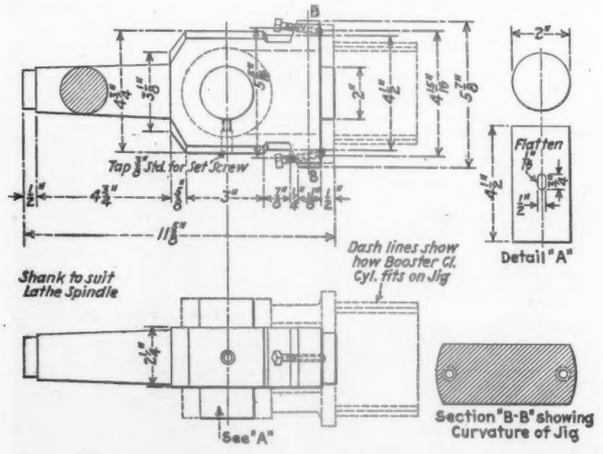
hoist shown at the left of the illustration, to lift the driving boxes on to a roller conveyer, which is shown in the foreground. The driving box is then pushed onto the plate and is moved under the ram by a return stroke of the piston in the air cylinder. This cylinder is operated by the valve on which the operator's hand is resting.

The control valves for lowering and raising the ram are also located at the operator's right. The piston or ram in the main cylinder of the press is raised by compressed air, while hydraulic pressure is used for the downward stroke. A 9½-in. air compressor is shown at the left. The air cylinder is bushed to 3 in. in diameter so that a pressure of 50 tons can be obtained if required. The pressure gages are located in front of the press.

When removing brasses, the boxes are placed on top of a U-shaped filler block, as is customary in practically all shops. The brasses fall on the plate, and the piston of the auxiliary cylinder is used to push them onto the roller conveyer. In this manner the press is made clear for the next box without any effort or time on the part of the operator.

Jig Designed for Boring Booster Clutch Cylinders

BOOSTER clutch cylinders, after being in service for some time, generally show an excessive amount of ring wear which usually appears on only one side of the cylinder wall. Owing to the irregular shape of the cylinder and the fact that the piston has to fit in the cylinder cap as well as in the movable cylinder, considerable trouble is usually experienced in reboring them accurately so that they are square with the rocker pin


Tap ⅜" Std. for Set Screw
Flatten
Detail "A"
Dash lines show how Booster Cl. Cyl. fits on Jig
Shank to suit Lathe Spindle
Section "B-B" showing Curvature of Jig
See "A"

The drawing of the jig with a clutch cylinder application shown by the broken lines

and the cylinder-cap threads. To overcome the tedious and difficult job of accurately boring these cylinders, the jig shown in the drawing was designed and has been used with gratifying results at the Kansas City shops of the Missouri Pacific Lines, and what had heretofore been a more or less inaccurate job consuming several hours is now completed in twenty minutes with the highest degree of accuracy. The jig automatically lines up the cylinder one way and it is trued for boring by means of the two set screws located as shown in the drawing. The complete set-up is accomplished in a very few minutes without any pressure or strain being placed upon the cylinder. In making the jig it is necessary that great emphasis be placed on the degree of accuracy used in laying off and boring the hole for the pin in section BB. This pin, shown in detail *A*, should be hardened and ground to size.

A Sand Blasting Machine

SHOWN in Fig. 1 of the following drawings is a simply designed sand blasting machine which is easily handled and conveniently moved from place to place. It consists of a drum, 2 ft. high and 2 ft. in circumference, to which is riveted a cone section with an

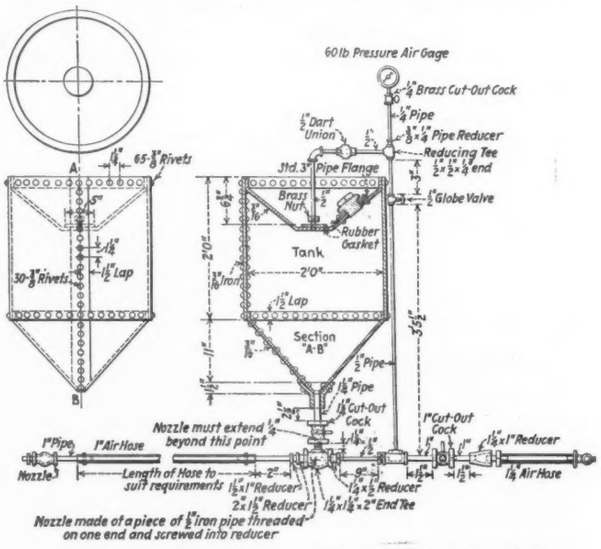


Fig. 1—The machine assembly, showing the piping arrangement

altitude of 11 in. Air at 60-lb. pressure, supplied from a 1¼-in. line, passes through a 1-in. cut-out cock into a ½-in. pipe leading to the top of the tank where it augments the gravity flow of sand to the nozzle at the base of the cone section. Air pressure from the 1¼-in. line

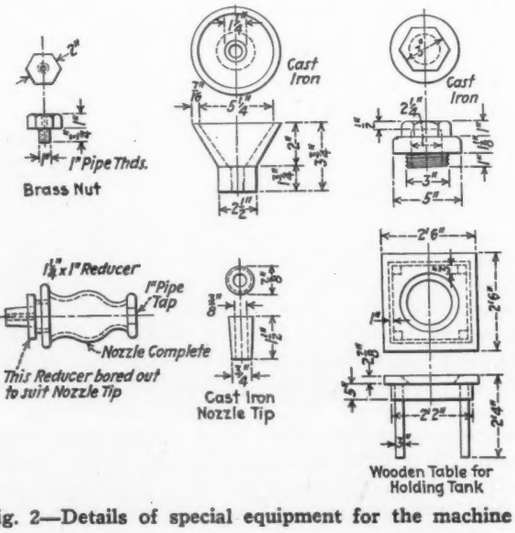
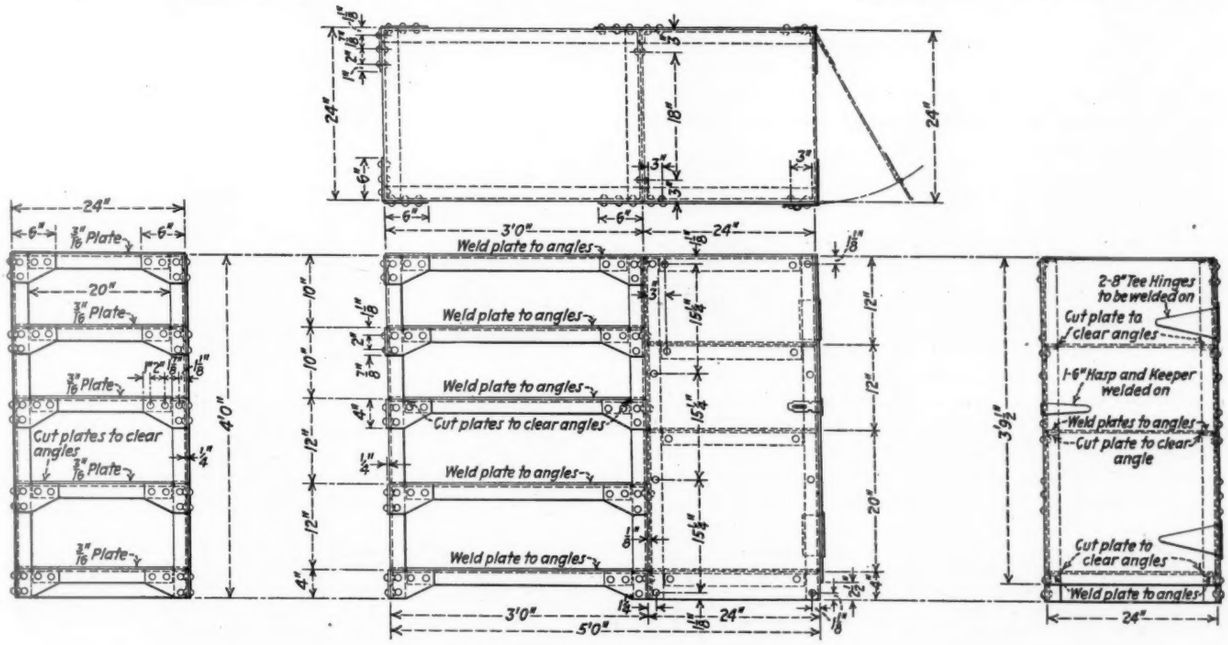


Fig. 2—Details of special equipment for the machine

passes through this nozzle, exhausting the sand into the distribution line which is equipped with an air hose for directing the stream of sand at any desired object. Fig. 2 shows the details of the brass nut for pipe connections of the air line leading into the drum, the plug for the hole through which the drum is filled, the nozzle tip for exhausting the sand into the distribution line, the distribution nozzle, the cap for the base of the cone section into which the sand delivery pipe is screwed and also the wooden table which supports the machine when in operation.

A Combination Tool Rack and Locker

THE following drawing of the combined tool rack and locker, designed especially for the use of wheel-lathe operators, shows the closed locker arrangement at one end of the rack and the four open shelves for the storage of tools and operating equipment used by the machine operator. The rack is 2 ft. wide, 3 ft. 9½ in. high and is 5 ft. long. The locker, comprising one end of the rack, is 2 ft. long and is built in three sections, one of which is 20 in. high and two which are each 12 in. high. The remaining 3 ft. of the rack is devoted to four open shelves, the lower two being 12 in. apart and the upper two 10 in. apart. The rack, which has been adopted as standard equipment on an eastern road is welded except where rivets are shown.



The wheel-lathe locker and tool rack

MONARCH LATHES.—The Monarch Machine Tool Company, Sidney, Ohio, has just published a 20-page illustrated book covering the installation and maintenance of lathes. While its title is "Monarch Lathes—Their Installation—Their Maintenance," the book is broad in scope and contains suggestions of value for the installation, operation and maintenance of all types of lathes. Various unusual problems of lathe operation are set forth in a Questions and Answers chapter and correct solutions suggested.

Copper Pipe Floor Manifolds

THE two manifolds, shown in the following drawings, were recently put in use on locomotives operating out of the El Paso shops of the Southern Pacific Lines for the express purpose of eliminating holes worn in various copper pipes which run through the cab floor and which are more or less free to rub against the floor, the firebox or each other. The round manifold is cut from 1-in. scrap boiler plate, finished to the dimensions shown in Fig. 1, and drilled with seven $\frac{13}{16}$-in. holes and two ¾-in. holes. Two ¾-in. machine bolts, brazed in the ¾-in. holes, are used to bolt the manifold flush with the floor decking. Pipe couplings are brazed in the $\frac{15}{16}$-in. holes and nipples of extra heavy W. I. pipe are screwed into the bottom of them. The nipples are terminated just below the running board where union connections are used for the pipes going to the booster, distributing valve, equalizing reservoir, cylinder cocks, dome pilot valve and the signal line. Nipples are also screwed into the couplings from the top and are equipped with union connections for the various pipes running to the gages and the two brake valves.

The round manifold is used where there is a large variety of these pipes running through the floor. The

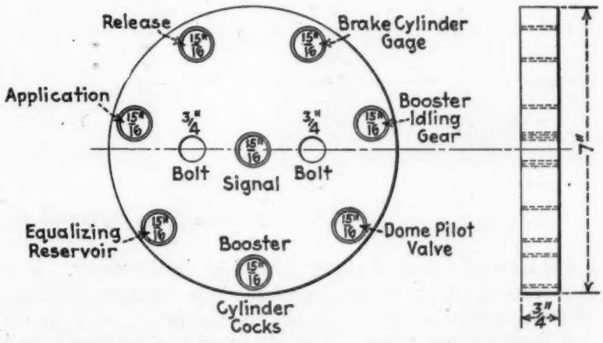


Fig. 1—The round manifold used for eight couplings

manifold shown in Fig. 2, used where a small number of pipes are to be coupled, is bolted to the floor in the same manner as the round manifold and the pipe connections are secured to it as just described. These manifolds, located underneath the automatic brake valve, not only prevent the pipes from wearing and cutting but they afford an opportunity for the coppersmith to line up his work in an orderly manner and give the cab a neat appearance.

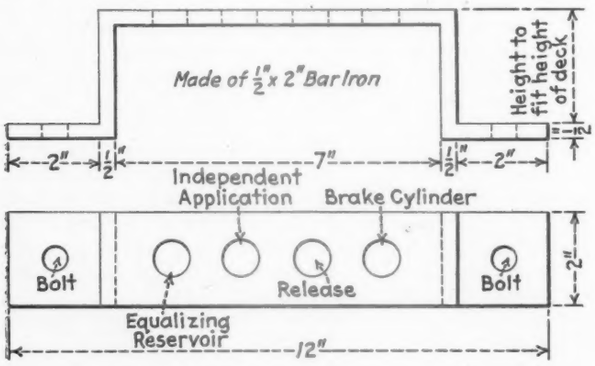


Fig. 2—The rectangular manifold for a small number of couplings

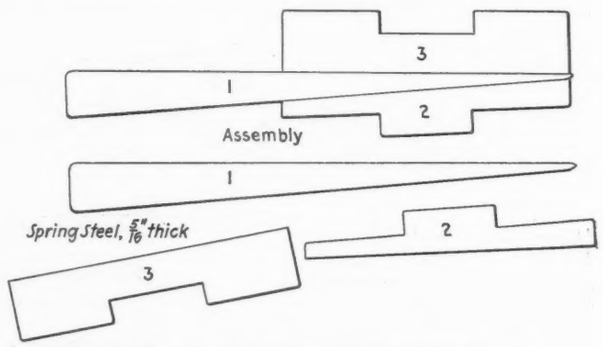
Press for Renovating Grease

SHOWN in the drawing is a shop-made press for renovating grease used for lubricating locomotive pins. It consists essentially of a wood bench, a Westinghouse type B driver brake cylinder, a type D freight-car brake cylinder, a grease strainer and a hopper. The driver brake cylinder is connected to the shop air line. The piston is made of a 3-in. rolled-steel bar, 2 ft. long, to one end of which an 8-in. by ¾-in. steel plate is screwed which serves as the piston. The strainer is made of a ½-in. steel plate, 5 3/32 in. in diameter. It is drilled with ⅛-in. holes placed as close together as practicable, within a circle 4½ in. in diameter, scribed on the face of the plate. The strainer nut is bored and tapped 12 threads per inch to fit over the end of the non-pressure head of the freight-car brake cylinder. The outside edge is knurled and has six ¼-in. by ⅜-in. slots for a spanner wrench.

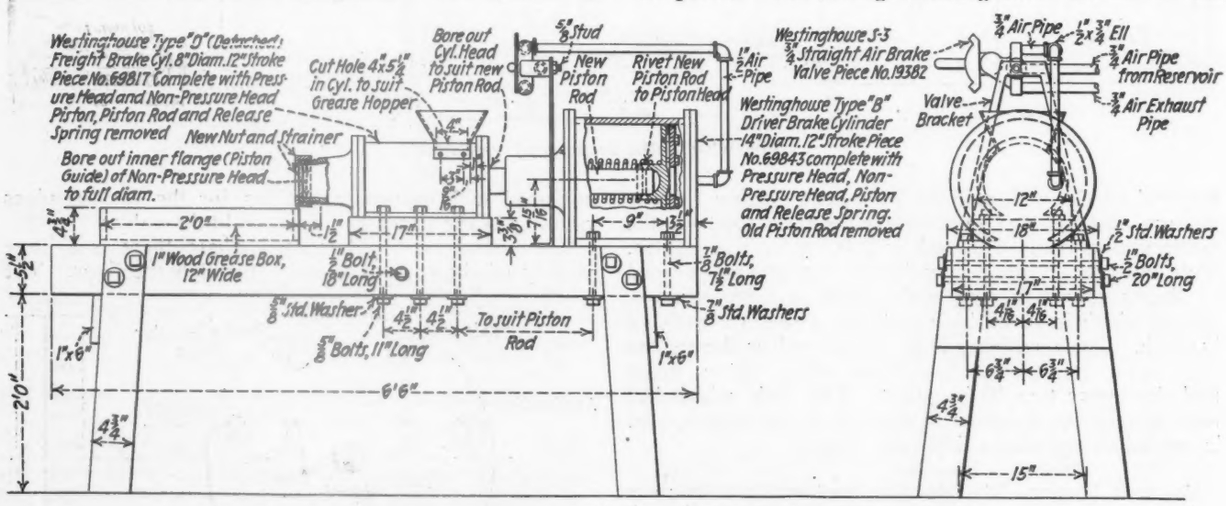
The hopper is made of 1/16-in. steel plates, welded at the seams and to the cylinder. It measures 8 in. by 10 in. at the top, and 4⅛ in. by 5⅜ in. at the bottom opening, and is 4 in. high. The long dimension is placed across the cylinder. This device is used by an eastern railroad and has proved satisfactory for the renovation of pins and other heavy grease.

A Piston Rod Puller

THE piston rod puller shown in the full-sized drawing below was designed for the extraction of Alco power reverse-gear pistons but has been found useful for separating all types of pistons secured with flat keys. In using the puller, the original key is removed from the rod and parts number two and three are placed in the back and front of the key way, respectively. The wedge is then applied, using a small hand hammer to spread the puller, the action of which easily extracts the piston. The saving resulting from the use of this type of puller comes not only from the ease with which the piston is extracted but also from the fact that in the application to Alco power reverse gears the piston is separated from the crosshead without removing the wrist pin.



Drawing of the piston extractor for Alco power reverse-gear pistons


Westinghouse Type "D" (Detached) Freight Brake Cyl. 8" Diam. 12" Stroke Piece No. 69817 Complete with Pressure Head and Non-Pressure Head Piston, Piston Rod and Release Spring removed
Cut Hole 4" x 5 1/2" in Cyl. to suit Grease Hopper
Bore out Cyl. Head to suit new Piston Rod
5/8" Stud
New Piston Rod
Rivet New Piston Rod to Piston Head
1/2" Air Pipe
New Nut and Strainer
Bore out inner flange (Piston Guide) of Non-Pressure Head to full diam.
Westinghouse Type "B" Driver Brake Cylinder 14" Diam. 12" Stroke Piece No. 69843 complete with Pressure Head, Non-Pressure Head, Piston and Release Spring. Old Piston Rod removed
Westinghouse J-3 3/4" Straight Air Brake Valve Piece No. 19382
3/4" Air Pipe
1" x 3/4" Ell
3/4" Air Pipe from Reservoir
3/4" Air Exhaust Pipe
Valve Bracket
2'0"
1 1/2"
17"
9"
3 1/2"
4 1/2"
5 1/2"
1" Wood Grease Box, 12" Wide
1/2" Bolt 18" Long
7/8" Bolts, 7 1/2" Long
7/8" Std. Washers
7/8" Std. Washer
4 1/2"
4 1/2"
To suit Piston Rod
5/8" Bolts, 11" Long
1" x 6"
1" x 6"
6'6"
21'0"
4 3/4"
12"
18"
1/2" Std. Washers
5/8" Bolts, 20" Long
17"
4 1/16"
4 1/16"
6 3/4"
6 3/4"
4 3/4"
15"

Press operated by compressed air for renovating locomotive pin grease

Welding Locomotive Cylinders

By E. P. Fairchild

Locomotive Shop Foreman, Atlantic Coast Line, Waycross, Ga.

THE economy of welding broken locomotive cylinders has been a controversial subject among mechanical-department foremen for a number of years. A few roads have abolished the practice of welding cylinders altogether, while a number of others only permit the practice to a limited extent. Without making any attempt to ascertain the difficulties that have been encountered by those shops which have abolished the practice, it may be that a large part of their trouble has been due to the lack of expert work on the part of the welders.

At the present time the Atlantic Coast Line has approximately 50 locomotives in service with welded cylinders. All of these locomotives are giving satisfactory service from the standpoint of cylinder life and maintenance. In August, 1929, a set of cylinders was broken so badly that it was necessary to remove them from the locomotive to make proper repairs. The broken portions of the cylinders were welded and returned to service at one-third the cost of a set of new cylinders.

The methods used on the Atlantic Coast Line for welding a cylinder which is badly broken are shown in the illustrations. The cylinder shown was removed from a freight locomotive on which the eccentric-crank pin of the valve gear broke causing the valve to block the

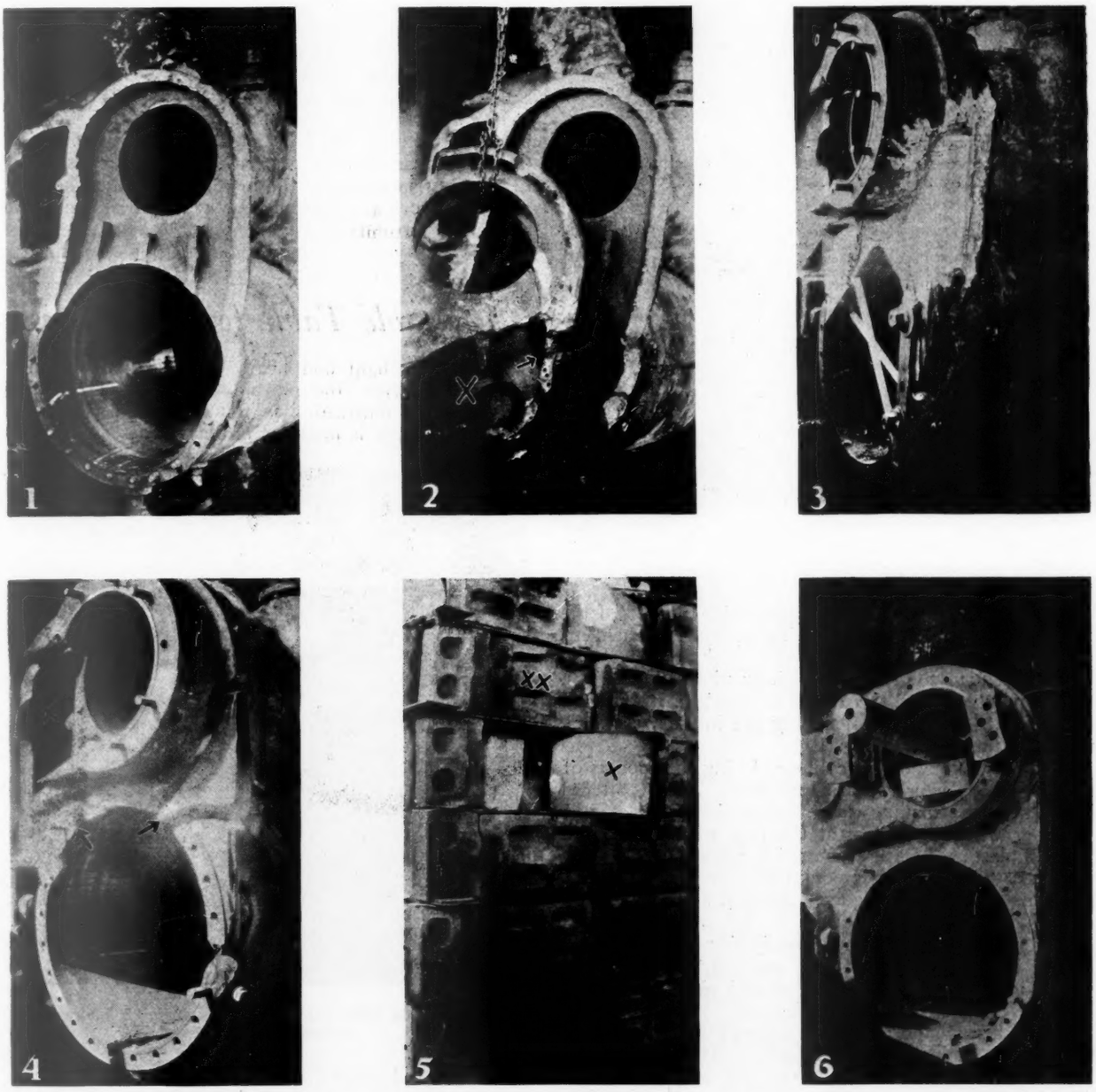


Fig. 1: The broken cylinder—Fig. 2: Section of cylinder which was broken off—Fig. 3: Making the plaster Paris patterns—Fig. 4: Ready for welding—Fig. 5: Construction of the brick furnace for preheating—Fig. 6: Ready for boring

exhaust steam port, and damage the end of the cylinder. The locomotive was traveling at a rate of about 50 m.p.h. at the time the accident occurred.

Two of the pieces broken from the cylinders could not be located and it was necessary to make plaster-of-Paris patterns from which new sections were cast. It was also necessary to remove the section marked *X* in Fig. 2 to permit making the weld indicated by the arrows in Figs. 1 and 2. On completion of this inside weld the section which had been removed was fitted in place and welded.

After all the broken parts and the cylinder had been properly chipped, cleaned and fitted together ready for welding, a brick furnace, shown in Fig. 5, was built around the cylinder and the whole assembly was preheated before beginning the actual welding operations.

The six illustrations show the condition of the cylinder before the repairs were made, the sequence of operations and the completed job. Referring to the figure numbers:

Laboratory Report on Tests of Welded Specimens Submitted by 21 Welders Employed at Waycross

Yield point, lb.	Tensile strength, lb.	Remarks	Efficiency, per cent
34,800	54,500	Fracture 1 in. from weld	100
33,600	49,500	Fairly good. Large lap in weld	90
31,000	51,800	Fracture 3½ in. from weld	100
40,200	61,300	Fracture 1 in. from weld	100
32,300	53,100	Fracture 1 in. from weld	100
39,600	60,100	Fracture 3½ in. from weld	100
37,100	59,100	Fracture 1½ in. from weld	100
33,200	53,000	Fracture 2½ in. from weld	100
38,000	60,200	Fracture 1½ in. from weld	100
35,800	51,250	Fracture 1 in. from weld	100
32,600	53,100	Fracture 3½ in. from weld	100
35,000	56,000	Fracture 1 in. from weld	100
35,600	54,000	Fracture 3½ in. from weld	100
31,600	52,250	Fracture 3 in. from weld	100
34,000	54,400	Fracture 2½ in. from weld	100
30,600	50,500	Fracture 2½ in. from weld	100
39,100	59,500	Fracture 3 in. from weld	100
36,600	58,000	Fracture 3½ in. from weld	100
35,900	58,100	Fracture 1 in. from weld	100
36,600	55,100	Fracture 3½ in. from weld	100
38,000	57,100	Small lap in weld	99
		Shop average	99.5

Fig. 1 shows the broken cylinder with the end of the valve chamber and portion of the cylinder broken entirely off.

Fig. 2 shows the section which was broken off. The arrow points toward the drilled holes which were made to facilitate the work of making the inside weld indicated by the arrow in Fig. 1.

Fig. 3 is a view of the cylinder during the process of making the plaster-of-Paris patterns. These patterns were used for making new sections for pieces of the cylinder which were lost at the time of the accident. No. 40 plaster-of-Paris was used for this job. The cast iron cost three cents per pound and the making of the patterns and castings required five hours of labor at 87 cents per hour.

Fig. 4 shows the cylinder ready for welding. The arrow indicates the new cast sections. The section marked *X* was placed in position and welded after the inside weld has been completed.

Fig. 5 is a view of the brick furnace which was built around the cylinder for preheating. The bricks were laid so that sections could be removed, as shown in the illustration, as the work of welding progressed. The brick X is shown removed from its position in the wall. When the welding at this point had been completed, this brick was replaced and the brick *XX* removed, and so on until the welding work was completed.

Fig. 6 shows the repaired cylinder ready to be bored and to have bushings applied.

No. 167 ¼-in. manganese-bronze rods were used for this job. Four welders at 87 cents per hour were required who worked a total time of 17 hrs. The oxy-acetylene process, as already indicated in this article, was used, and a total of 20 ft. of welding was required. Following is an itemized list of labor and material:

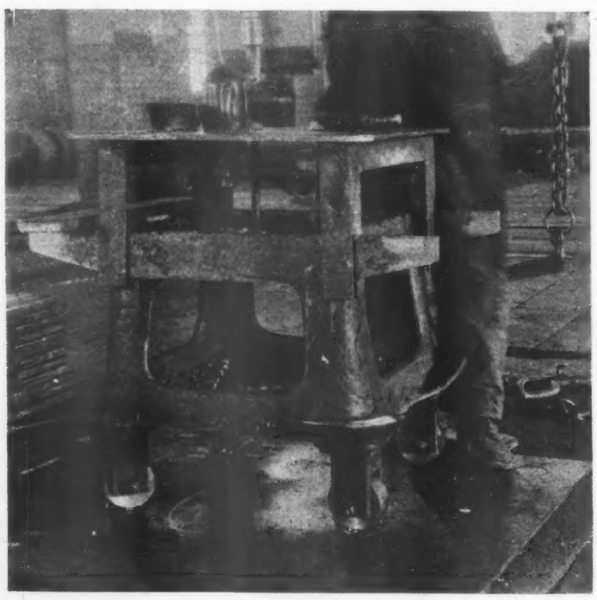
Manganese bronze	$72.80
Oxygene and acetylene	$30.70
Labor, 34½ hr. at .87	$30.02
Labor, 8 hr. at .21¼	$ 1.70
Total cost of welding	$135.22

This job was performed last spring and the locomotive to which it was applied was placed in service in April, 1929. The repaired cylinder has given satisfactory service since that time.

A large part of the credit for the quality of welding performed in these shops is due to the high standards maintained for the welders. Each autogenious welder and welder apprentice is required to submit a specimen weld for testing every six months. The efficiency report for October, 1929, is shown in the table. If a welder's efficiency falls below 85 per cent, he is given further instructions and the methods by which he performs his work are carefully checked. He is then given another opportunity to qualify.

Adjustable Table for Drill Press

WHERE light and heavy work is handled on a drill press, the movable and adjustable table shown in the illustration is found to be very handy. The table proper is mounted on heavy castors to allow it to be moved away from the press while heavy material is placed on it with an air hoist. At the top two bars of 1-in metal extend up about 6 in. at each corner. An auxiliary table, for the lighter material which does not require so much room, is fitted with slots in the 3-in. angle-iron legs, which fit down over the projections on the main table. This brings the table up to a more comfortable height for drilling small pieces of material.



Adjustable table used for handling light and heavy work around a drill press

NEW DEVICES

Martin Circulator Tests

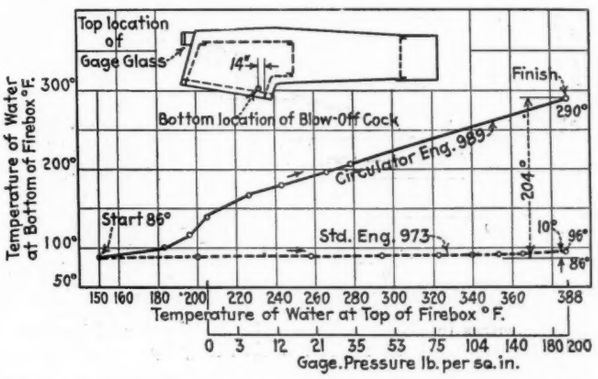
IN September, 1928, a Texas & Pacific 2-10-2 type locomotive, No. 541, burning oil, was put into service after being equipped with a Martin circulator* manutactured by the Locomotive Boiler Economizer Company, Los Angeles, Cal. Since that time it has gone from shopping to shopping and is now back in heavy pooled freight service. The locomotive was placed in the Marshall (Texas) shops for Class 3 repairs after making 76,477 miles during a period of 23 moths over all divisions of the railroad so that its performance might be observed under widely varying conditions of service.

On removal of the tubes a careful interior examination of the boiler and firebox sheets was made and the surfaces of all the sheets were found to be in good condition, with no indication of corrosion or pitting. Normally an engine of the same size and class and under the same operating conditions requires a full tube renewal at the end of 50,000 miles.

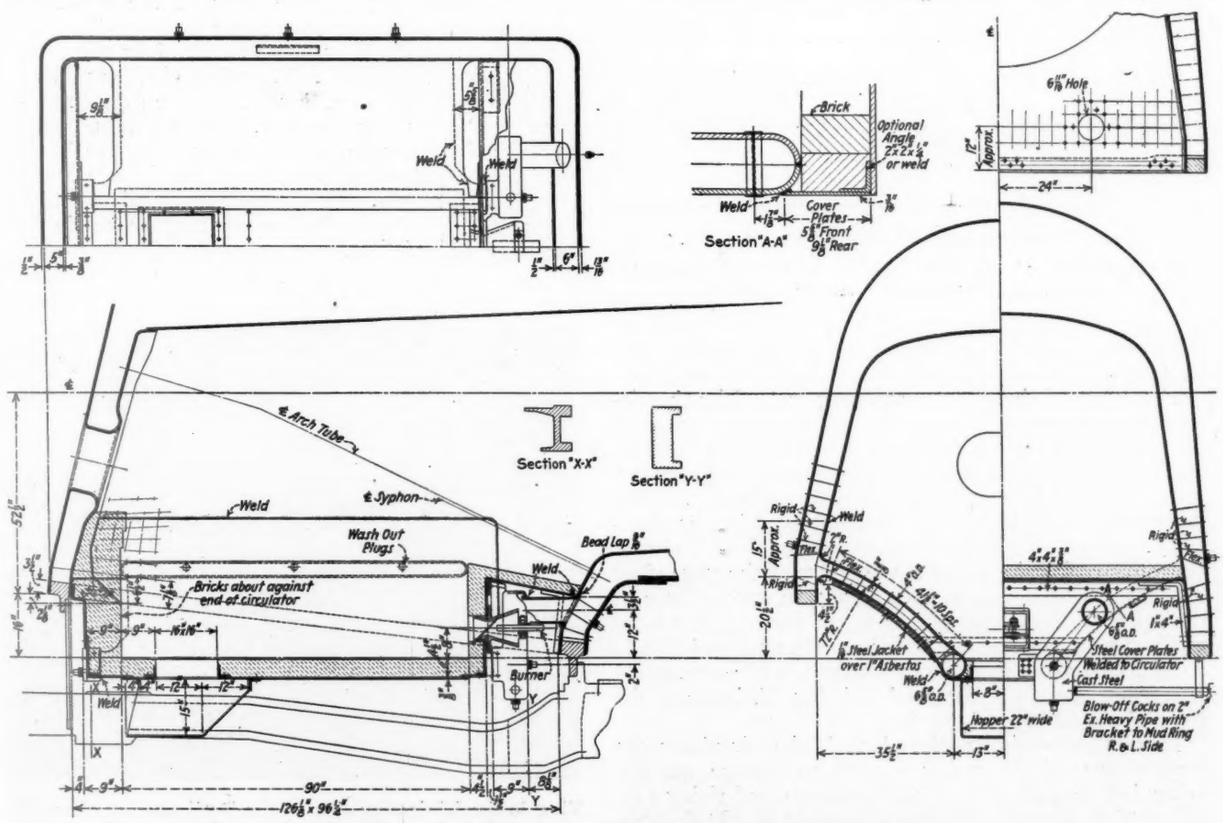
After receiving Class 3 repairs the locomotive was again placed in regular service in September, 1929, and as of January 1, 1930, has made a total of approximately 90,000 miles. The circulator as originally installed is at present in the locomotive in good condition, and records show that its cost of maintenance has been a negligible factor, justifying fully its installation as a means of protecting the firebox sheets, tubes and shells at a minimum cost. The low cost of maintenance of the circulator is accounted for by the continuous and rapid circulatory movement of the water which it occasions, being the means of not only circulating water through itself, but effecting a decided stimulation of water movement through the water legs of the firebox and the dormant spaces of the boiler shell surrounding the tubes.

From the condition of the firebox and boiler disclosed by the interior examination of locomotive No. 541 and experience with other 2-10-2 locomotives of the Texas & Pacific subsequently equipped with the circulator, it is expected that the circulatory movement of the water

*For a description of the Martin circulator as installed on this locomotive see the *Railway Mechanical Engineer* for September, 1923.

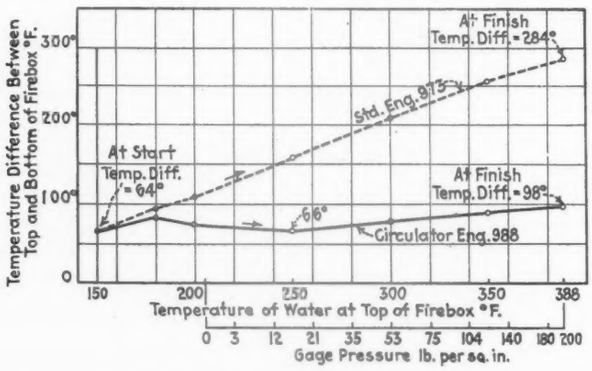


Water temperatures at the top and bottom of the firebox while firing up



The Martin Circulator designed with throat-sheet connections

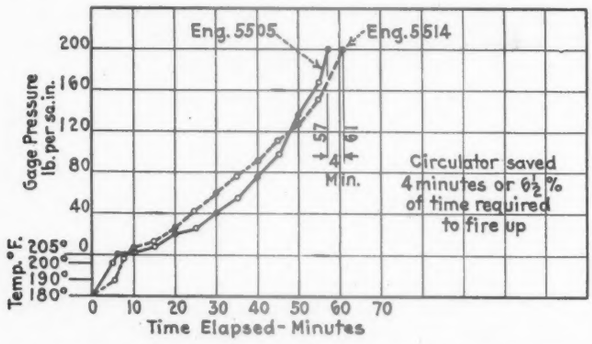
effected will double the life of fireboxes and boiler tubes. While offering this protection to the firebox and boiler, the generation of the rapidly moving water into steam has consistently shown a fuel saving of ap-



Differences in water temperatures at the top and bottom of the firebox while firing up

proximately 10 per cent on locomotive No. 541 and all other locomotives equipped.

As now applied, the steel feed pipes supplying the circulator with water are secured in the throat sheet by beading over their ends against the inner side of the sheet and welding to the outer side of the sheet in a manner similar to the application of arch tubes. The



A comparison of the time required to fire up locomotives with and without the Martin circulator

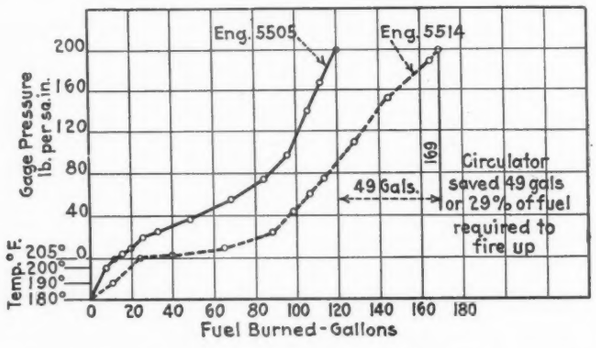
feed pipes are entirely without the firing chamber and consequently are not subjected to the heat of combustion.

The effect of the water movement created by the circulator is illustrated graphically by the curves showing the results of a test made on the Southern Pacific, Texas and Louisiana Lines, under the direction of J. A. Power, superintendent of motive power and equipment. Two locomotives of the same size and class and in like physical condition were fired up on adjoining pits. Thermometers recorded the water temperature at the gage glass and at the blow-off cock. No change in temperature of the water in the bottom of the leg of the standard locomotive was made until the boiler pressure reached 150 lb. per sq. in. and when the locomotive popped there was a difference in temperatures of 284 deg. F. between the top and the bottom of the firebox.

In the locomotive equipped with the circulator the temperature of the water started to change quickly, being 140 deg. F. at zero gage pressure and rising rapidly so that when the locomotive popped at 200 lb. pressure there was a temperature of 290 deg. F. in the bottom of the leg, or a difference in temperature between the top and the bottom of the firebox of only 98 deg. F.

Another graphic illustration shows the fuel saving effected by the circulator in firing up in enginehouses. These curves cover tests made on Chicago, Burlington & Quincy oil-burning locomotives at Casper, Wyo., under the direction of H. H. Urbach, superintendent of motive power. The fuel saving is 49 gallons, or 29 per cent. in bringing the locomotive up to the popping point of 200 lb. pressure. Tests on other lines are said to show a consistent fuel saving for firing-up which can generally be taken as 25 per cent of the fuel required in the conventional type of oil-burning firebox.

Road tests have determined that circulator-equipped



A comparison of the fuel oil burned in firing up locomotives with and without the Martin circulator

locomotives carry their water well even though objectionable priming conditions exist.

During the past two years it has been demonstrated that, by eliminating the fire brick of the conventional fire-pan arrangement from the side sheets and bottom of the firebox, locomotives can be turned in three hours quicker time at terminals. There is no brick against side sheets to cool down before water can be safely removed from the boiler for washing. Locomotives equipped with the circulator do not pop from excessive heat energy stored in the fire brick when the throttle is closed after a heavy pull. On booster-equipped locomotives having the circulator, the booster may be cut in for a longer period of time.

* * *

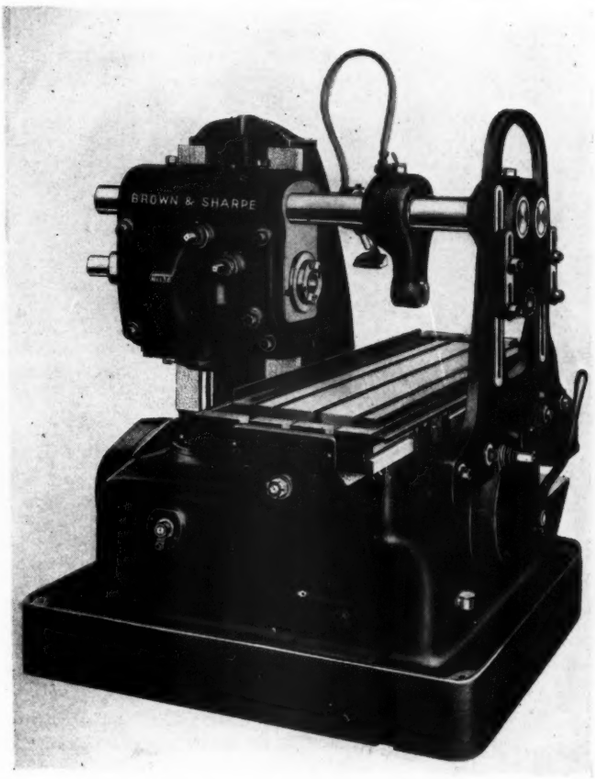
View in the fabricating shop of the Burlington steel car shop at Galesburg, Ill.—Punched and fabricated parts are turned out in large quantities

Brown & Sharpe Plain Milling Machine

THE Brown & Sharpe Manufacturing Company, Providence, R. I., has completely redesigned its No. 13B plain milling machine. The redesigned machine is noteworthy for compactness of design, rigidity and powerful cutting qualities as well as simplicity of control. The feed ranges and capacity dimensions are nearly the same as those of the previous machine. It has a longitudinal feed of 34 in. and a transverse and vertical adjustment of the spindle of 4 in. and 12 in., respectively. The transverse adjustment for the spindle is obtained through a 7¼-in. sliding sleeve which carries the spindle and its bearings, clamped rigidly in position by four bolts. The spindle head is massive and can be adjusted without fear of crimping or sagging, owing to the method of gibbing. The feed, which is exceptionally smooth even under extreme cutting conditions, is made by a revolving nut mounted on a large-diameter stationary screw.

The bed, table ways and column are cast in one piece with frequent internal bracing webs. The table ways are 42 in. long and support the table for almost its entire length. The table is wide and thick and the top, which is finished as a working surface, is 32 in. above the floor. The arbor yokes, cutters and arbor can be removed without disturbing the outer brace, which can be left attached to the bed of the machine at all times if so desired. A rugged tie between the bed and the overarms, which are of the double type, is afforded by this brace, which rigidly trusses all supporting members and reduces vibration to a minimum.

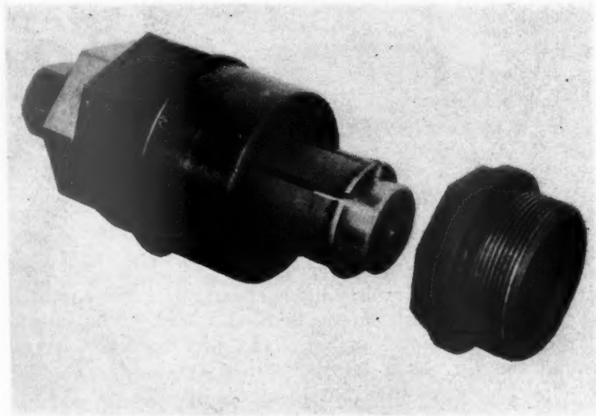
The machine can be operated with entirely automatic table functions when desired but a variety of operating cycles can be obtained by means of adjustable dogs. A control lever, operating all power movements of the table, is directional and the change from cutting feed to power fast travel is obtained by a movement of the lever in a direction at right-angles to the table axis. The drive is entirely through splined shafts and gears supported by closely spaced, anti-friction bearings. The position of the driving pulley at right angles to the table permits batteries of these machines to be driven by one line shaft, using a minimum of floor space.



The redesigned B & S milling machine

An Air-Compressor Valve-Seat Remover

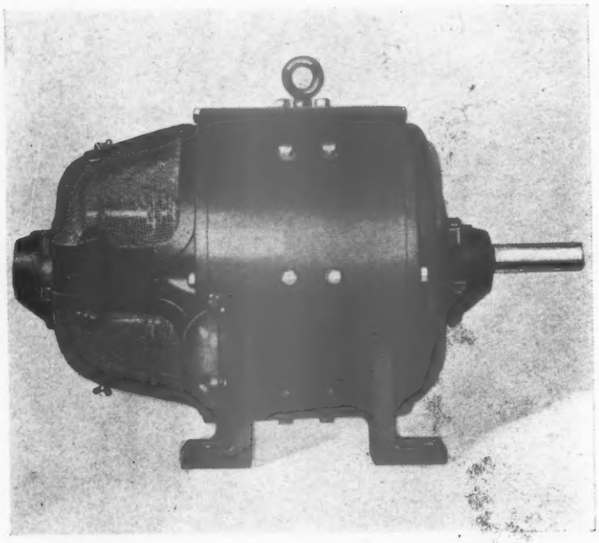
A TOOL for removing air compressor valve seats without chipping or burning and which will not damage the bushings and threads or distort the valve seats has recently been developed and placed on the market by the Foster-Johnson Reamer Company of Elkhart, Ind. The tool is placed in position and the split sections are expanded to a larger diameter than the diameter of the hole in the valve seat by tightening the small hexagon nut at the top of the device. The split sections are provided with a stop which safeguards against over expansion. When the sections are expanded the large hexagon nut is tightened, the action of which draws the tool down securely on the octagon of the valve seat. An open-end wrench is applied to the tool and the valve seat removed. Tension of the tapered shaft in the split collet is released by loosening the small hexagon nut on the top of the tool and tapping on the ball end of the shaft. This tool incorporates a socket wrench that is locked firmly in place on the top of the bushing and cannot slip off. The upper end of the tool is machined to accommodate a large wrench so that sufficient leverage can be applied to remove the tightest of bushings.



The expanding tool shown with a valve seat

A Planer Motor for Reversing Service

A HEAVY duty planer motor for reversing service has recently been announced as an addition to the line of the Reliance Electric & Engineering Company, Cleveland, Ohio, and will be identified as the type D reversing planer motor. This motor has a frame of rolled or cast steel, is built to stand hard service and is



The Reliance Type D planer motor for reversing service

designed with substantial feet having liberal machined mounting surfaces. Special attention has been given to the accuracy of the mounting surface dimensions which are of importance in coupling the motor directly to the planer.

The armature is long and small in diameter to reduce the flywheel effect and to lessen the time required for reversal. The shaft is made of forged high-carbon steel, machined all over and accurately ground to size. All the bearings are cast-iron shells lined with a high-grade white-bearing metal, but ball or roller bearings can be supplied if so desired. The main field coils are of bobbin construction which prevents the coil winding from moving as a result of vibration.

The operator pushes a button to start and stop the planer but aside from this the controller is entirely automatic in operation, every movement being governed by a master switch. Dynamic braking provides quick stops whenever the stop button is pressed or the master switch is thrown into mid-position. Dynamic braking also occurs in case the direction switch should fail to close, for any reason whatsoever, at the end of the stroke. Time-limit overload protection insures the immediate opening of contactors in the case of heavy overloads while lighter overloads are carried until their value may become harmful to the motor. In case of low-voltage or complete failure of voltage, the motor is stopped immediately by dynamic braking, regardless of the direction of the operation. Dynamic braking is effected directly by the planer motor acting as a self-excited generator.

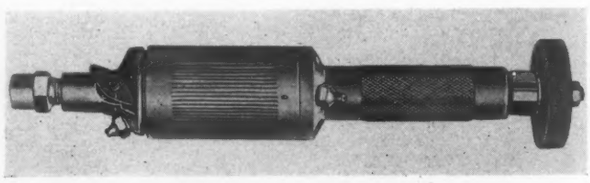
The controller utilizes the plugging method for reversing, power being applied to the motor all the time during reversing from full speed in one direction to full speed in the other.

Freedom from losses due to belt trouble, more power at the tool, greater overload capacities, cutting speeds maintained in uneven cuts and fine graduations of speed with independent adjustments for cuts and returns, are the advantages claimed for this directly connected planer motor for reversing service.

Rotary Pneumatic Grinders

TWO pneumatic grinders based on the rotary principle have been developed by Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, and added to its line of Thor rotary air grinders. The two grinders have the outstanding advantages of light weight, governed speed, increased power and lack of vibration, and are designed to eliminate the mechanical inefficiency generally found in piston-type grinders. The rotary grinders are made in a complete line of sizes and types for all requirements. The line ranges from grinders having a speed

The 260G Thor grinder

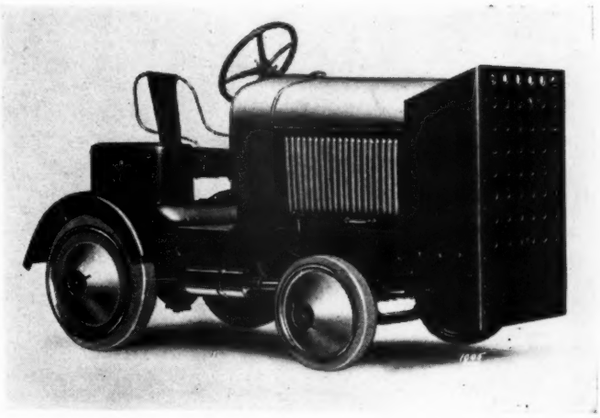


The 00 Thor grinder

of 28,000 r.p.m. and carrying a 1¼-in. elastic bonded wheel to grinders having a speed of 4,300 r.p.m. and carrying an 8-in. elastic bonded wheel. The latter of these two grinders is No. 260G which weighs 13½ lb., and the former is No. 00 which weighs 2¾ lb. and is particularly adapted for touching up dies, etc. Due to the rotary principle of these grinders, the air consumption and upkeep costs are low.

The W & K Industrial Tug

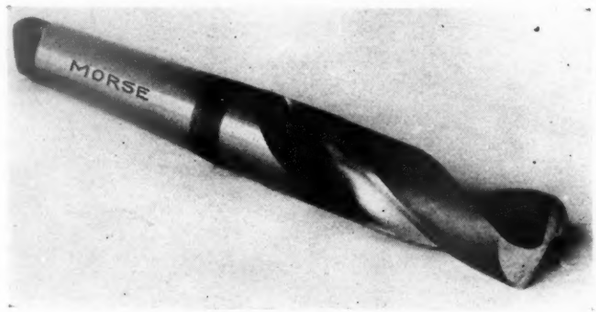
THE Industrial Tug, shown in the photograph, manufactured by Whitehead & Kales Company of Detroit, Mich., is a gasoline type of tractor employing the standard Ford model AA truck motor as its power unit. The tractor is designed for all industrial hauling purposes and is ideally suited for use wherever a small but powerful unit is required. It is spring mounted, front and rear, is 8 ft. in overall length and has a turning radius of 8 ft. All wearing parts are standard Ford AA truck parts—motor, four-speed transmission, radiator, starter, steering gear and spindles—a practice that simplifies servicing and keeps service expense at a minimum. The tractor has a drawbar pull of approximately 1,500 lb. with a speed of 19.7 miles per hour in fourth speed, at 2,000 r.p.m. Its total weight is approximately 2,450 lb. and it is furnished complete with battery, coupler, radiator guard, spring seat, generator and starter. The wheels are cone-shaped of the self-deflecting disc type.



The Whitehead & Kales tractor designed for all industrial hauling purposes

Cobalt Steel Drills

DURING recent drilling tests made by the Morse Twist Drill & Machine Company, New Bedford, Mass., a twist drill of Cobalt steel was developed for drilling manganese railroad frogs and other equipment of similar hardness. Experimenting with Cobalt steel drills, made up along the lines of the regular Morse product and identified by the trade name of the Circle C drill, it was found that they gave particularly satisfactory results and where exceptionally hard work was encountered the machine speed was greater than that when ordinary high-speed steel drills were used. The Circle C drills have overcome many of the problems of drilling such as the drilling of boiler plates, cast-steel mud rings, cast-steel frames, brake-beam-hanger forgings, drivers, etc. These tools have the ability to hold a sharper cutting edge and give greater penetration between point grindings and in many instances have shown from 50 to 200 per cent more holes per grind than the regular high-speed tools.



The Morse Circle C drill

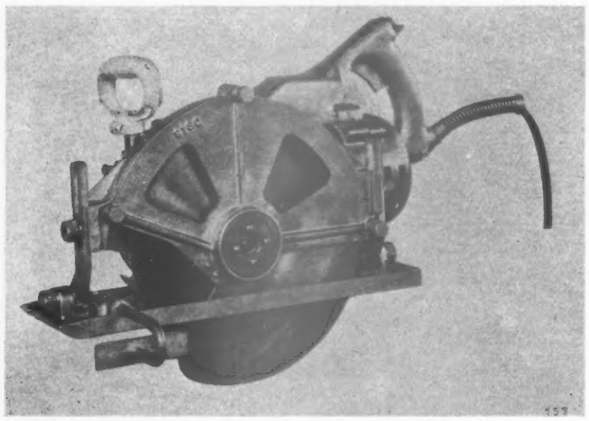
Speedway Portable Electric Saws

THE Speedway Manufacturing Company, 1834 South Fifty-second street, Cicero, Ill., announces the addition of two electric portable saws to its line, Nos. 183 and 184, which are equipped with 10-in. and 12-in. blades, respectively. The former carries a ¾-hp. G. E. motor and runs at a no-load speed of 1,800 r.p.m. while the latter is powered by a full horsepower G. E. motor running at a no-load speed of 1,750 r.p.m. Both of these saws operate on either alternating or direct current.

The slipper-plate base of these saws can be raised or lowered for adjustment of the depth of the cut, the maximum cut of the 10-in. blade being 3-⅜ in. and that of the 12-in. blade 4-⅜ in. They are equipped with swinging saw guards which automatically push out of the way when cutting pressure is applied and which return to guarding position the moment pressure is released. The upper portion of the saw blade is covered with a well-designed saw guard of cast aluminum, the side cover of which is quickly and easily taken off for changing blades by loosening three knurled nuts which are so attached that they cannot be lost. The entire saw-guard structure is well designed so that it will not collect saw-dust.

The machines follow the characteristic Speedway design in using spur and bevel gears which, together with all the shafts, are made of heat-treated chrome-nickel steel, fitted with ball bearings. All gears and bearings are packed in grease and require a minimum of attention. Saw blades are mounted on the left side of the

machine to give maximum visibility to the operator. These blades are driven through a carefully designed driving flange which drives positively and without the necessity of clamping the blade tighter with the spindle nut than enough to hold it in place. On both models a



The Speedway 1-hp. portable electric saw

ripping guide is mounted on the front of the slipper plate to facilitate long cuts.

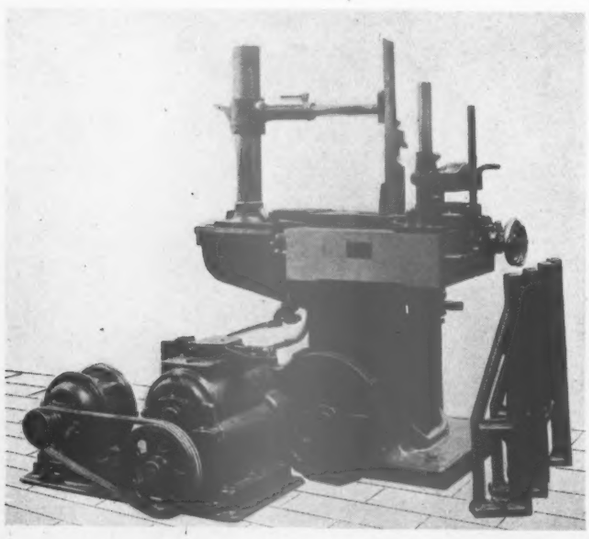
Both saws are equipped with a D-type handle which, together with the motor cases and slipper plates, is of cast aluminum and which is adjustable to a variant of either of two possible positions to fit the conditions demanded by each individual operator. The two tools, considering the quality and weight of the material put into them, are compact and light and are well balanced to make their operation non-fatiguing.

A Reversing Driving Unit for Keyway Cutters

THE Morton Manufacturing Company, Muskegon Heights, Mich., has recently placed on the market a directly connected reversing driving unit designed for application to its stationary keyway cutters which are built with 18-in., 24-in., 28-in., and 48-in. cutting strokes.

The driving unit is of box type construction with powerful multiple disc clutches, running in oil, so geared as to give a two-to-one quick-return ratio. The shafts are all mounted on Timken roller bearings. This unit eliminates the countershaft and belts usually furnished with stationary keyway cutters, because it is directly connected to the machine with a flexible coupling and it is powerful, quiet running and positive in its reversal.

The unit has been so designed that it can be applied to any Morton stationary keyway cutter that is now in use.

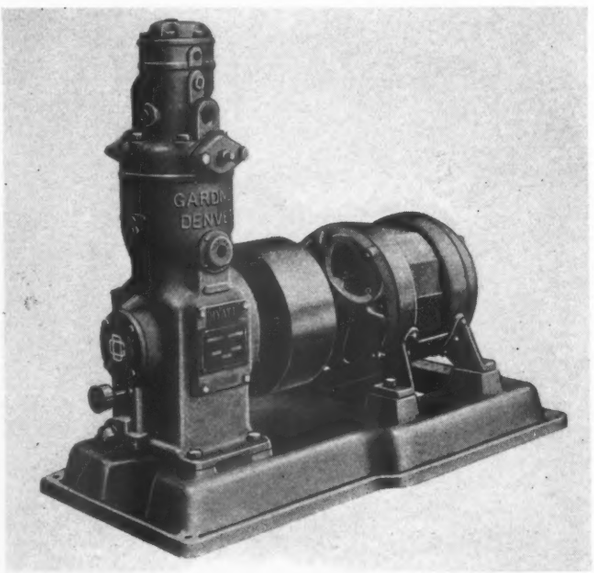


Key seater with directly connected reversing driving unit

Gardner-Denver Two-Stage Air Compressor

A TWO-STAGE air compressor of the vertical tandem type, which is known as the ABA, has been placed on the market by the Gardner-Denver Company, Quincy, Ill.

The new compressor weighs only 350 lb. and will produce a continuous flow of 24 cu. ft. of air a minute at pressures up to 500 lb. per sq. in. The low-pressure head, high-pressure cylinder and inter-cooler are combined in a single casting. This simplified construction reduces the number of parts to a minimum and eliminates the usual system of jacket and air piping. The main bearings are of the Hyatt roller type. Lubrication is positive and automatic, being effected by a combination oil pump and splash system.



The low pressure head, high pressure cylinder and inter-cooler are combined in a single casting

The ABA compressor can be furnished with pulley for a belt drive or for direct connection to an electric motor, steam or gas engine. It is particularly suited for oil- and gas-engine starting and other services requiring small volumes of air at moderately high pressures.

Among the Clubs and Associations

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—The 1930 convention of the American Railway Tool Foremen's Association will be held on September 10, 11 and 12 at the Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—September 16, 17, 18 and 19 are the dates announced for the annual meeting of the International Railway General Foremen's Association to be held at the Hotel Sherman, Chicago.

AIR BRAKE ASSOCIATION.—It has been unofficially announced that the Air Brake Association will hold its 1930 convention at the Hotel Stevens, Chicago, instead of in Minneapolis, Minn. Lack of hotel accommodations at Minneapolis necessitate this change in meeting place.

ST. LOUIS RAILWAY CLUB.—Colonel F. G. Jonah, chief engineer, St. Louis-San Francisco, will be the principal speaker at the next meeting of the St. Louis Railway Club which will be held February 14 at 8:00 p.m. at the Statler Hotel, St. Louis, Mo. The special feature of that meeting will be a Valentine party.

PACIFIC RAILWAY CLUB.—The Pacific Railway Club will hold its next meeting February 13 at 7:30 p.m. at the Hotel Oakland, Oakland, Cal. The subject to be discussed will be Car Handling and Car Distribution and a number of speakers have been invited, the names of whom are to be announced.

AMERICAN SOCIETY FOR STEEL TREATING.—The American Society for Steel Treating held its semi-annual meeting at the Hotel Pennsylvania, New York, on February 7 to 8, inclusive. Papers of interest to mechanical department officers were presented on the following subjects:

Nickel Alloy Steel Forgings, by Charles McKnight, International Nickel Company, New York.

Transformation and Constitution of High Chromium Steels, by Takejiro Murakami, Kojin Oka and Seiji Nishigori of the Department of Metallography, Tokohu Imperial University, Sendai, Japan.

Recent Developments in Normalizing Sheet Steel, by Edward S. Lawrence, Duraloy Company, Pittsburgh, Pa.

Metals for Vitreous Enameling, by J. H. Nead, American Rolling Mill Company, Middletown, Ohio.

AMERICAN STANDARDS ASSOCIATION.—It was recently announced that the American Standards Association had become a member body of the International Standards Association in which the following countries are represented: Austria, Belgium, Czechoslovakia, Denmark, Finland, France, Germany, Holland, Hungary, Italy, Japan, Norway, Poland, Roumania, Russia, Sweden and Switzerland. All of the national standardizing bodies, except those of Great Britain, Canada and Australia, are now members of the International Standards Association. The American Standards Association has made an agreement with the United States Bureau of Standards in which it has been provided that the bureau will promulgate commercial standards particularly for industries having no organized standardization procedure. The following associations have been added to the membership of the A. S. A. during the past year: The Tap and Die Institute, the Milling Cutter Institute and the Drill and Reamer Society.

Club Papers

Inspecting Main Trackers

Eastern Car Foremen's Association.—Meeting held at the Engineering Society Building, 29 West Thirty-ninth street, New York, December 27, 1929. Paper by A. H. Keys, general car foreman, Baltimore & Ohio, Pittsburgh, Pa.

Mr. Keys presented a paper on freight car inspection in which he described the *A* and *C* method of inspection as used on the Baltimore & Ohio in conditioning cars for main tracker freight service. About six months ago the B. & O. adopted the *A* and *C* system and discontinued the *A, B* and *C* system of inspection which had been in effect for several years. The latter method was functioning efficiently under the old system of train operation but was found to be defective when used in connection with the operation of extended locomotive runs and main tracker freight service.

Cars received at interchange or junction points receive the *A* inspection. This inspection provides for a rigid inspection of all parts of a car, either loaded or empty, with the object of discovering all defects that may exist in the equipment which would cause failure before the car reached its destination. The *C* inspection is for the purpose of making general observations to discover any I. C. C. defects. This inspection also includes the lading on open-top cars and is given to trains in yards where inspectors are permanently located.

Mr. Keys, in conclusion, stated that the following satisfactory results had been obtained during the six months that the *A* and *C* method of inspection had been in effect: The elimination of intermediate inspection between the points of origin and destination; a reduction in the number of cars shopped en route; a reduction in the number of cars placed on rip tracks for repairs; a reduction in the switching cost of handling crippled cars at intermediate points; a reduction in the number of failures and accidents on account of old defects, and increased rapidity in the handling of trains over the road and through terminals.

Air Brakes

New York Railway Club.—Meeting held in the Auditorium of the United Engineering Society Building, 29 West Thirty-ninth street, New York, on January 17, 1930. Paper by S. G. Down, vice president, Westinghouse Air Brake Company, Wilmerding, Pa.

Mr. Down presented a paper on the Contribution of the Air Brake to Modern Transportation in which he described the developments of the air brake from 1869 to the present time. His paper covered not only the various types of equipment used in railroad service, but also the latest developments in electro-pneumatic, street car, highway vehicles and airplanes. Mr. Down also told of the many problems that had been solved in the past and pointed out a number of problems that remained to be solved but were now receiving attention from air brake engineers. An abstract of Mr. Down's paper, together with the ensuing discussion, will appear in the March issue.

Safe Car Work

Chicago Car Foremen's Association.—Meeting at Chicago, December 9, 1929. Address by Harry Guilbert, director of safety, Pullman Company. The entire evening at this meeting of the association was devoted to a discussion of safety with particular reference to car department work. In addition to the principal address, which was highly inspirational in character, a moving picture was shown illustrating unsafe practices, and several selections were rendered by a quartet of Pullman porters.

Mr. Guilbert was signally successful in keeping away from dry statistics and "sob stuff" in his address which was generously interspersed with amusing stories. The first of these, offered as his explanation for not reading a prepared paper, was suggested by Mrs. MacTavish's reply to the Presbyterian minister who asked her opinion of his written sermon. She said, I I didna like it for three reasons: first, you read it; second, you didna read it well; and third, it wasn't worth reading."

Mr. Guilbert's speech may perhaps be best summarized as an urgent appeal for car foremen to realize their responsibility in instructing the many men under their jurisdiction by force of example and leadership since "safety cannot be forced down any man's throat." He urged the adoption of a standard blue flag derail

in every railroad yard and emphasized especially the desirability of compulsory wearing of goggles for eye protection. He maintained that if the President of the United States, himself, were to visit a Pullman shop he would not be permitted to pass through the shops without first being supplied with goggles. As a result of intensive safety efforts, the Pullman record for the first ten months of 1929 was 5.71 accidents per million man-hours, the best safety record in the history of the company, and a record which should prove a source of inspiration to many railroad car departments.

A Railroad Cinderella

St. Louis Railroad Club.—Meeting at St. Louis, Mo., December 13, 1929. Paper by Z. G. Hopkins, assistant to the president of the Missouri-Kansas-Texas.

Mr. Hopkins called attention to the fact that in spite of the tremendous development of motor transportation on the highways in the past decade, as well as the development of inland waterway transportation and air transportation, the railroads have performed a larger volume of service year after year for the people of the county in the movement of goods and merchandise. He likened the railroads, constantly confronted with limited net return and demands for better service and lower rates, and the establishment of joint rates with competitive publically-financed inland waterways, to Cinderella, the step-child who split kindling, washed the pots and pans and was forbidden all the fineries as well as participation in the pleasures of the household.

Mr. Hopkins said, "If the highways or the inland waterways or the air will effect, with the assistance of mechanical developments, more efficient, more convenient exchange of commodities and facilitate intercommunication between the various sections of the country, we, as good citizens and forward-looking men, all welcome and desire to hasten that development. He maintained, however, that past experience has demonstrated the absolute dependence of the country for progress and prosperity upon adequate steam railroad service. Mr. Hopkins did not quite complete his analogy between the experience of Cinderella and that of the railroads for it will be recalled that in the end Cinderella married the prince, whereas the solution of the railroads' problem is not yet apparent.

Draft Gears

The Pueblo Car Men's Association.—Meeting at Pueblo, Colo., January 24 and 25.

The entire discussion at this two-day meeting of the association was devoted to the subject of draft gears, under the direction of Chairman H. A. Magrath, chief interchange inspector, Pueblo, Colo., and Secretary I. F. Wharton, chief clerk of the Interchange Bureau. F. A. Weymouth, chief metalurgist of the Colorado Fuel & Iron Company, delivered an address, emphasizing the necessity of designers and manufacturers of railway equipment of all kinds working closely with those who use the equipment to determine what changes and improvements in their design will best meet service requirements. P. C. Withrow, mechanical engineer of the Denver & Rio Grande Western, gave an interesting account of the development of draft gears from the first spring gears to modern high-capacity friction gears. R. J. Cook, president of the Keyoke Railway Equipment Company, Chicago, described the Peerless friction draft gear and elaborated at some length upon the results of tests of this gear conducted at the Purdue University draft-gear test laboratory, subsequent to the A. R. A. tests. Joe Marshall, special representative of the American Railway Association, discussed the influence of draft-gear action on unlocated damage and rough handling to car-load freight. One of the most effective addresses at the meeting was given by T. E. Moffett, representing the National Malleable & Steel Castings Company, who illustrated the operation of National draft gears with pencil sketches and, in a heart-to-heart talk to the many railroad car men present at the meeting, demonstrated his knowledge of actual operating conditions and gave the men many practical suggestions regarding draft-gear conditions which require correction. In this connection, sectional draft-gear models were displayed which assisted materially in illustrating gear action. The Colorado Fuel & Iron Company also had an extensive exhibition of practically all of the important materials which it manufactures for railroad use.

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal building, New York. Next meeting, May 13 to 16, Hotel Stevens, Chicago.

AMERICAN RAILWAY ASSOCIATION.—DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual convention June 18-25, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting, Sept. 9-11, 1930, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St. New York. Annual convention June, 1930, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago. Next meeting, September 10, 11 and 12, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

RAILROAD DIVISION—Paul D. Mallay, chief engineer, transportation department, Johns-Manville Corporation, 292 Madison avenue, New York.

MACHINE SHOP PRACTICE DIVISION.—Carlos de Zafra, care of A. S. M. E., 29 West Thirty-ninth street, New York.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—L. H. Morrison, associate editor, Power, 475 Tenth avenue, New York.

FUELS DIVISION.—A. D. Black, associate editor, Power, 475 Tenth avenue, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting Atlantic City, N J., June 23-27.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andruceiu, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 7836 So. Morgan street, Chicago, Ill. Regular meeting, second Monday in each month, except June, July and August. Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meetings second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. G. Weigman, 720 North Twenty-third street, East St. Louis, Ill. Regular meeting, first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill.

CENTRAL RAILWAY CLUB.—Regular meeting, second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September at Hotel Hollenden, East Sixth and Superior Ave.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings fourth Monday of each month.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting September, 1930, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. T. Winkles, Room 707, LaSalle Street Station, Chicago. Next meeting May 6-9, 1930 Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash street, Winona, Minn. Next meeting, September 16 to 19, inclusive, Hotel Sherman, Chicago.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER BOILERMAKER'S ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood St., Albany, N. Y. Annual meeting May 21-24 William Penn Hotel, Pittsburgh, Pa.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September. Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. Mrs. M. E. Hartman, acting secretary, 26 Cortlandt street, New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.

PUEBLO CAR MEN'S ASSOCIATION.—I. F. Wharton, chief clerk, Interchange Bureau, Pueblo, Colo.

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, chief clerk, Peoria & Pekin Union Railway, 217 Lydia avenue, Peoria, Ill.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meetings third Thursday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Ft. Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Master Car Builders' & Supervisors' Association.

TRAVELLING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Next meeting September 23-26, 1930, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

NEWS

THE CANADIAN PACIFIC has completed the installation of a new 100-ft. turntable at London, Ont., to replace a former 70-ft. turntable.

THE MAINE CENTRAL has awarded contracts to the American Bridge Company, Ambridge, Pa., for the construction of a new 110-ft. turntable at Waterville, Me., at an estimated cost of $55,000.

THE TEXAS & PACIFIC has awarded a contract to Robert E. McKee, El Paso, Tex., for the construction of a 23-stall enginehouse and other terminal facilities at Big Spring, Tex.

THE MISSOURI PACIFIC has warded a contract to the Roberts & Schaefer Company for the furnishing and erection of a multiple-track "N. & W." type electric cinder handling plant which is now being built at Atchison, Kan.

THE LOFFLER high-pressure locomotive, which is designed to operate at a steam pressure of about 1,900 lb. and with a superheating temperature of about 900 deg. F., has been completed and is now being tested on the German State Railways. It is reported that the results of the first tests have been satisfactory.

THE SHOPS of the Atlantic Coast Line at Tampa, Fla., where about 500 men are employed, have not had occasion to report an injury to an employee since October, 1927, and during that time, the force has worked 2,715,769 man-hours. James Grant has been shop superintendent since January, 1927, but has recently been promoted to superintendent of motive power. His successor, W. C. Stephenson, is carrying on the same splendid work.

THE CANADIAN NATIONAL, during 1930, plans additions to its terminal facilities at Yarmouth, N. S.; the continuation of work on an engine terminal now under construction at Charlottetown, P.E.I.; the installation of a 100-ft. turntable at St. John, N. B.; the construction of a 350-ton coaling plant at Campbellton, N. B.; additions to its yard and terminal facilities at Sarnia, Ont., and the erection of a coaling plant at Mimico, Ont. Work is also to be continued on the $5,000,000 seven-year program for the improvement of the Point St. Charles shops at Montreal, with the construction of a new foundry, oil-storage facilities, fire-up shed, water connections and new trackage.

Illinois Central Co-ordinates Standardization Work

THE ILLINOIS CENTRAL has recognized and co-ordinated its supervision of standards of materials and practices employed in construction and maintenance work, with the vice-president in charge of purchases and stores as chairman of the two committees under whose jurisdiction that work has been placed. Besides the vice-president, the committee on mechanical standards is made up of the general superintendent of motive power, the superintendent of the car department and the engineer of tests.

A Ten-Thousand-Dollar Prize

AN ANNUAL PRIZE of $10,000, accompanied by a gold medal, is announced by Popular Science Monthly (New York City) to be awarded to the American citizen who has been responsible for the achievement in science of greatest potential value to the world. The prize will be conferred for the first time in September, 1930, and the initial period of scientific accomplishment will be the twelve months ending June 30, 1930. Twenty-four leaders in American science are to serve as a committee of award, under the direction of Professor C. P. Bliss, associate dean, New York University.

Milwaukee Opens New Car Shop

ON JANUARY 25 the Chicago, Milwaukee, St. Paul & Pacific opened, with appropriate exercises, at Milwaukee, Wis., one of the largest and best-equipped freight car shops in the country. This shop, 196 ft. wide and slightly over 1,000 ft. long, is of steel and glass construction, fully provided with crane facilities, machine tools and modern spray-painting equipment, and cost in excess of one million dollars. Some idea of the magnitude of the building may be obtained from the fact that approximately 6,000 people were seated and standing before the speakers' platform, erected in one end of the building, at the opening of the dedication exercises.

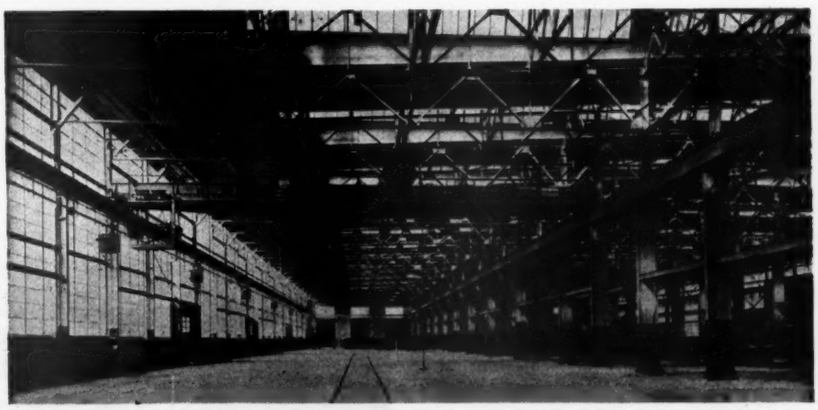
Among the speakers and guests of honor were the Mayor of Milwaukee, who made a brief address, followed by H. A. Scrandrett, president of the Chicago, Milwaukee, St. Paul & Pacific, and J. T. Gillick, vice-president. Throughout the dedication exercises, emphasis was placed on safety and, following some general remarks on this subject, M. J. Flanigan, assistant to the general manager, in charge of safety, introduced the principal speaker of the day, W. H. Jones, director of safety and first aid of the Canadian National. The dedication exercises were in charge of K. F. Nystrom, superintendent of the car department of the Milwaukee, with the aid of J. A. Deppe, assistant superintendent of the car department, and G. Reichart, superintendent of the new freight car shop. A feature of interest was the appeal for loyalty and co-operation between railroad and employees, made by J. J. Hennessy, assistant superintendent of the car department, and formerly for many years master car builder of the Milwaukee.

Wage Statistics for November

THE TOTAL NUMBER of railway employees as of the middle of the month of November, 1929, was 1,680,063, a decrease of only .02 per cent as compared with November, 1928, according to the preliminary statement of Class I railways as reported to the Interstate Commerce Commission. As compared with November, 1927, however, this was a decrease of 2.83 per cent. As compared with November, 1928, there was an increase of 1.83 per cent in the maintenance of way and structures group, but decreases of .68 per cent in maintenance of equipment and stores, .73 per cent in train and engine service, .45 per cent in yardmasters, switch tenders and hostlers, and 1.67 per cent in other transportation employees.

Canadian Pacific's High Pressure Locomotive

DESIGNS has been completed by the Canadian Pacific, the Superheater Company and the American Locomotive Company, and construction work is to be started at the Angus shops of the railroad on the double-pressure steam



New million-dollar car shop of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis.

locomotive referred to briefly in the June, 1929, issue of the *Railway Mechanical Engineer*. The locomotive is to have a tractive force of 83,200 lb. and will be operated on a high steam pressure principle. It will be one of the most powerful locomotives in the world and will supersede the 5900 series as the most powerful in the British Empire. The tractive effort will be 5,200 lb. more than the 5900 series, and 37,900 lb. greater than the 2800 series of fast and modern passenger locomotives. The new locomotive will have a two-wheel leading truck, five pairs of driving wheels and a four-wheel trailing truck and will be known as the Canadian-Pacific T-4-a class. The locomotive alone will weigh about 466,500 lb. and the tender 297,000 lb. It will operate under multiple pressure and will burn fuel oil. High pressure steam will be used in the middle cylinder at 850 lb. pressure. The steam will be generated by heat interchange coils in the high pressure drum, the coils being part of a sealed system of tubes and headers which will contain distilled water. A pressure of about 1,350 lb. will be carried in the closed generating system and heat interchange coils. The forward end of the boiler will be of the conventional type and will generate steam at 250 lb. pressure per square inch. The high pressure steam will be superheated and, after passing through the high pressure cylinder, will be supplemented by superheated steam from the low-pressure boiler and fed to the two low-pressure cylinders. The exhaust from the outer or low-pressure cylinders will be utilized in a feedwater heater in the customary way and will furnish the usual stack draft. The locomotive will have three cylinders, the high-pressure or middle cylinder being 15½-in. diameter by 28-in. stroke and the two outer or low-pressure cylinders 24-in. diameter by 30-in. stroke. The tender will be a duplicate of the existing types with a fuel oil capacity of 4,100 Imperial gallons and a water capacity of 1,200 Imperial gallons.

Procurement Officers Wanted for the U. S. Army Reserve

THE WAR DEPARTMENT has announced that there are a number of vacancies for officers in the Procurement Division of the Engineers Corps and Ordnance Department of the United States Army Reserve. Many types of men and many qualifications are needed in the procurement service in time of emergency, including accountants, financial experts, inspectors, lawyers, liaison officers, personnel experts, production specialists, purchasing officers, research specialists, statisticians and traffic experts. The ranks range from second lieutenant to colonel during peace time.

Railroad officers and supervisors who are interested and feel themselves qualified for service in the Procurement Division as commissioned officers are requested to write to the chief of the branch of service in which they are interested. Address your letter thus: War Department, Office of the Chief Engineer, Washington, D. C.

Safety Program for February

CIRCULAR No. 251 of the Safety Section, A. R. A., which has been issued by E. R. Cott, chairman of the Committee of Education, is devoted to admonitions emphasizing the precautions necessary to be taken in railroad work at this time of

year because of the presence of snow and ice. Prevention of the formation of ice, where practicable, is one of the duties to be remembered, as is indicated by the picture of a fireman taking water. Other

Safety Section Bulletin No. 80

pictures in this pamphlet show the wisdom of sweeping off ice and snow from footboards of tenders and from grab irons. The man who knocks down a big icicle from the eaves of a shop or office building may sometimes be a benefactor to a fellow employee who might be standing beneath when such an icicle broke off and fell.

During the extreme weather of January and February last year, a number of railroads issued instructions forbidding men to mount or dismount from any moving engines or cars "during prevailing weather conditions." Among ten suggested rules in this pamphlet is one dealing with this point. Another rule suggests that trainmen should wear short overcoats; long ones may prevent free use of limbs. Employees should be warned that when bundled up in thick clothing, special care must be taken to look out for approaching cars or engines which may not be heard. "Make available ice grippers, to be worn on shoes when weather conditions require." A spell of severe cold weather is a time when hostlers should take special care never to move an engine without first ringing the bell.

B. & M. Children Assisted by Loring Fund

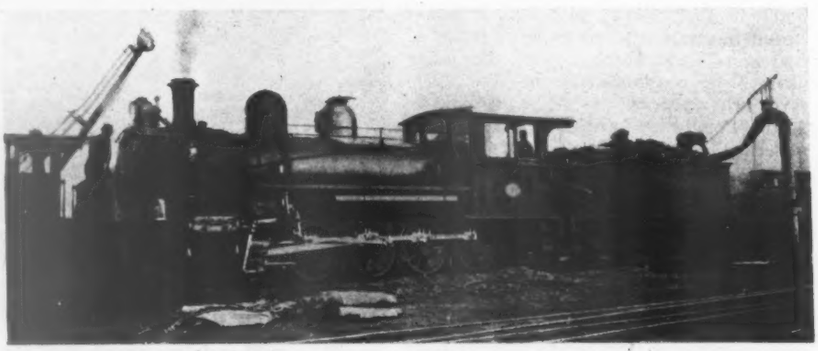
SONS AND DAUGHTERS of employees of the Boston & Maine, to the number of 57, have been assisted in their college education in the school year 1929-30 by scholarships from the Boston & Maine Railroad Employees Fund, according to a report made to the trustees.

Young men and young women in universities, normal schools, business colleges, music schools and other institutions of learning have been given substantial sums toward the cost of their tuition. In all, $4,000 was allotted for the present school year.

The fund, which was created in March, 1928, upon the retirement of Homer Loring as chairman of the Executive Committee, is one to advance the general welfare of the employees. Income from the trust is also used to provide free medical treatment for employees at the Massachusetts General Hospital, where two free beds have been established by the fund.

The youngsters who have been helped in the present school year embrace those of a wide range of the employees including the following taken at random from the report: Foremen, passenger trainmen, enginemen, time keepers, conductors, inspectors, agents, switch tenders, janitors, stevedores, gatemen, chief clerks, telegraphers, towermen, fuel foremen, computers, signalmen, and road foremen.

* * *



Freight 4-8-0 type locomotive on the New Zealand Government Railways

Supply Trade Notes

CHARLES P. CLAMPITT has been appointed manager of the Chicago office of the Alexander Milburn Company.

THE PYLE-NATIONAL COMPANY has moved its New England branch office to 901 Statler building, Boston, Mass.

THE CHAIN BELT COMPANY, Milwaukee, Wis., has opened a New England district office at 950 Park Square building, Boston, Mass. J. K. Merwin is district manager.

HIBBARD S. GREENE, former vice-president and director of the Barber-Greene Company, Aurora, Ill., has been appointed assistant to the president of the Chain Belt Company, Milwaukee, Wis.

ARTHUR M. LONG, who has been in charge of the tin plate sales of the Youngstown Sheet & Tube Company, has been appointed assistant general manager of sales with headquarters at Chicago.

S. L. WILLIAMS has been appointed district engineer for the eastern district of the Westinghouse Air Brake Company at New York. Mr. Williams was graduated from the Massachusetts Institute of Technology as a mechanical engineer in 1923, and immediately entered

S. L. Williams

the employ of the Westinghouse Air Brake Company as special apprentice in the Wilmerding works. After serving for several months as inspector in Boston and New York, he was, in 1925, made assistant to the district engineer at the latter place. In 1928 he was transferred to the west coast and promoted to assistant district engineer of the Pacific district at San Francisco, which position he held until his recent promotion.

THE O'BRIEN EQUIPMENT COMPANY, 2726 Locust boulevard, St. Louis, Mo., has been appointed a distributor for the Mason Regulator Company, in the Missouri territory. The products of the Mason Company include pressure regulators, damper regulators, balanced valves and reducing valves.

HAL W. REYNOLDS has been appointed direct factory representative of the Taft-Peirce Manufacturing Company, Woonsocket, R. I. Mr. Reynolds' headquarters will be at 1724 St. Clair avenue, Cleveland, Ohio.

THE OHIO BRASS COMPANY, Mansfield, Ohio, has opened a branch office in the Northern Life Tower at 1218 Third avenue, Seattle, Wash., in charge of J. M. Watkins.

L. E. FRIES has joined the sales force of the United States Electrical Tool Company, Cincinnati, Ohio, as Cincinnati district manager, succeeding R. H. Clore, who was recently appointed general sales manager.

NORMAN C. NAYLOR, district sales manager of the American Locomotive Company and the Railway Steel Spring Company, at Chicago, has been appointed vice-president of both companies,

Norman C. Naylor

with headquarters at Chicago. J. D. Finn, assistant secretary of the American Locomotive Company, has been appointed secretary of the American Locomotive Company, succeeding W. Spencer Robertson who resigned to become president of the Permutit Company, and Henry S. Banghart has been appointed assistant secretary of the American Locomotive Company, both with headquarters at New York. Mr. Naylor was born in Rochester, N. Y., on June 3, 1881, and entered the employ of McKee-Fuller & Co. on September 8, 1895. In June, 1896, he left this company to attend school in Colorado, after which, on July 5, 1898, he entered the employ of the Steel Tired Wheel Company. He became associated with the Railway Steel Spring Company in 1902 when the former company was merged with the latter. In December, 1916, he was appointed sales agent in the Chicago district and in November, 1926, was appointed district sales manager of both the American Locomotive Company and the Railway Steel Spring Company.

THE BARCO MANUFACTURING COMPANY, Chicago, has completed a three-story addition to its factory in that city. The building, which doubles the former floor space is of reinforced concrete construction.

P. G. JENKS, vice-president of the Standard Steel Car Company, with headquarters in Chicago, will be transferred to Paris, France, with the same title, to take charge of the extensive interests of this company abroad.

ALEC S. FIELD, formerly with the Shell Petroleum Corporation, Dallas, Texas, in charge of the eastern division, has resigned to go with the Naylor Pipe Company as assistant director of sales, with headquarters at Chicago.

WILLIAM H. BECK has become associated as sales engineer with the Fort Pitt Steel Casting Company, McKeesport, Pa., makers of carbon and alloy steel castings by the electric furnace process. J. Trantin, Jr., has become associated with the same company as metallurgical engineer.

WILLIAM CRANE BABBITT has joined the staff of the Industrial Truck Association, New York City, as field engineer. Mr. Babbitt is a graduate of the University of Michigan, and has had ten years experience in the management of industrial plants and in the trade association field.

THE GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., has acquired all of the refractories properties of Evens & Howard Fire Brick Company, St. Louis, Mo. The refractory plants of the Evens & Howard Fire Brick Company will in the future be operated by the General Refractories Company as the Evens & Howard division.

S. E. LINDERMAN has been appointed publicity manager of the United States Pipe & Foundry Company, Burlington, N. J., to succeed J. D. Copron, who has resigned to become general manager of the Glamorgan Pipe & Foundry Company, Lynchburg, Va.

FINAL ARRANGEMENTS were made at a meeting held Monday, January 27, at Cleveland, Ohio, for the merger of the Pittsburgh Forgings Company, Coraopolis, Pa., and the Greenville Steel Car Company, Greenville, Pa. The Pittsburgh Forgings Company will acquire all the common stock of the Greenville Steel Car Company which has assets of more than $1,000,000. The transaction involves the issuance of 20,000 shares more of Pittsburgh Forgings common stock bringing the total to 220,000 shares.

ROBERT M. DERBY has been elected a vice-president of the Niles-Bement-Pond Company in charge of its foreign business, with headquarters at New York. The company handles abroad the products of the Niles Tool Works Company, the Pratt & Whitney Company, and the Niles division of the Shepard-Niles Crane & Hoist Corporation. Mr. Derby has been with the Niles-Bement-Pond Company the greater part of his business career, commencing as an appren-

tice in its shops after receiving his engineering training at the Massachusetts Institute of Technology, in the class of 1901.

VERL E. MCCOY, combustion engineer of the Chicago, Milwaukee, St. Paul & Pacific, has entered the service of the Bird-Archer Company as assistant to president (mechanical engineer), with office at 122 South Michigan avenue, Chicago. Mr. McCoy was born on December 17, 1900, at Lincoln, Neb. He was graduated from the Montana State College in mechanical engineering in the class of 1925 and immediately entered the service of the St. Paul as a special apprentice, becoming combustion engineer of that railroad in 1928.

C. C. OSTERHOUT, chemical engineer formerly with the Rome Iron Mills, Rome, N. Y., has been appointed manager of sales of the Rome division of the Wrought Iron Company of America with headquarters at Lebanon, Pa. Mr. Osterhout was graduated from Cornell

C. C. Osterhout

University in 1904 and became associated with the Rome Iron Mills in 1911 as chemist and engineer of tests in 1925 he was appointed assistant manager of sales and during 1929 was manager of sales. As manager of sales of the Rome division of the Wrought Iron Company of America Mr. Osterhout will have exclusive charge of sales of Rome staybolt and engine bolt irons.

ERWIN R. BRIGHAM, vice-president and secretary of the North American Car Corporation, Chicago, has been elected president to succeed his father, Henry H. Brigham, who died on January 4. General Robert E. Wood, president of Sears, Roebuck & Co., has been elected to the board of directors to fill the position formerly held by Henry H. Brigham. Mr. Brigham had been vice-president and secretary and a director of the company for the last ten years. He began work in the purchasing department of the company immediately after the war and served as head of several of the departments, particularly the tank car and poultry car divisions. During the past year the North American Car Corporation has developed the Frigicar, an automatic refrigerator car; increased its fleet of cars, and has acquired the Live Poultry Transit Company.

L. P. DUGGAN, special railroad representative, Philadelphia, Pa., of the Garlock Packing Company, Palmyra, N. Y., has been appointed district manager of the Philadelphia branch. Mr. Duggan served from 1904 to 1910 in the stores department of the Chesapeake & Ohio at Richmond, Va., and during the next

L. P. Duggan

ten years he was connected with the Philadelphia branch of the Garlock Packing Company, as special railroad representative. From 1920 to 1923 he served with the United States Rubber Company, as railroad representative in Baltimore and in New York territory. Since 1923 he has been with the Garlock Packing Company at the Philadelphia branch as special railroad representative.

FREDERICK ALAN SCHAFF, vice-president of the Superheater Company, has been elected president, George L. Bourne, retiring president, having been elected chairman of the board of directors. Mr. Schaff, whose headquarters remain at New York,

Frederick Alan Schaff

was born at Nelsonville, Ohio, on May 24, 1884. After his graduation from Purdue University in 1907, he spent several years in the mechanical department of the Boston & Albany and the New York Central Lines. Following a period of several years' residence in Texas, in charge of business interests there, Mr. Schaff became associated with the Superheater Company, in its service department, in 1913. He was elected vice-president in 1915.

THE INTERESTS OF the Worthington Pump & Machinery Corporation, New York, are now served in the California territory through a local company, the Worthington Machinery Corporation of California, Ltd., with headquarters at Los Angeles and San Francisco. H. D. Cornell, who has been president of the Worthington Machinery Corporation of Oklahoma, is president of and will direct the new corporation, moving to California for that purpose. George W. Hawkins, who has been director of sales at New York, is now with Worthington California as vice-president. The new corporation has taken over the sales and engineering staff and the warehouse facilities of the Worthington Company, Inc., in California, and will hereafter handle all that territory.

Obituary

HENRY A. COLES, Atlanta district manager of the Westinghouse Electric & Manufacturing Company, died recently at New Orleans, La., of heart failure.

JOHN H. MITCHELL, general sales manager of the Standard Steel Car Company, with headquarters at Pittsburgh, Pa., died suddenly on January 16 while on a visit to the New York office of the company, Mr. Mitchell was born on August 30, 1872, at New Brighton, Pa. After graduating from Cornell University in 1896 as a mechanical engineer, he entered the service of the Pittsburgh & Lake Erie, as an engineman. Several years later he went with the Pressed Steel Car Company as western sales manager and 18 years later he served as acting president of the American Steel Company, Havana, Cuba. He remained in Cuba for three years and on his return to the United States became general sales manager of the Standard Steel Car Company.

ABRAM FRANCIS HUSTON, chairman of the board of the Lukens Steel Company, died on January 12 at his home, Coatesville, Pa. Mr. Huston was born on July 7, 1852, and was educated at Taylor Academy and at Haverford College, from which he was graduated in 1872 with the degree of bachelor of arts. On leaving college he at once entered the employ of the Lukens Iron Works and served in the mill. He held positions in various departments, after which he served as bookkeeper, purchasing agent and sales agent. In 1882 when his father retired from the management, he was put in control of the business: In 1890 the company was incorporated under the name of the Lukens Iron & Steel Company. In 1897 Mr. Huston was elected president of the company which had been known since 1917 as the Lukens Steel Company. In 1925 he became chairman of the board. In 1902, Mr. Huston was elected president of the Association of Steel Manufacturers and to the chairmanship of its executive committee.

Personal Mention

General

PETER B. ROGERS has been appointed superintendent of shops of the Atchison, Topeka & Santa Fe at Chicago, succeeding G. D. Woods, retired.

GEORGE W. RINK, assistant superintendent of motive power of the Central of New Jersey, with headquarters at Jersey City, N. J., has been transferred to Elizabeth, N. J., as mechanical engineer.

FRANK H. BECHERER, superintendent of the car department of the Central of New Jersey, with headquarters at Jersey City, N. J., has been appointed assistant superintendent of motive power and equipment, with the same headquarters. Mr. Becherer was born on August 23, 1882, in New York City. He

Frank H. Becherer

entered railway service in 1901 as billing clerk on the Erie, serving in that position until 1903, when he became assistant chief clerk of the car department. In 1904 he was appointed piecework supervisor of the car department and the following year he became chief clerk of that department. In June, 1907, Mr. Becherer resigned to enter the service of the Pennsylvania, subsequently serving as billing clerk, freight car repairer, freight car inspector, air brake inspector, piecework inspector, traveling inspector, assistant foreman car inspector (freight), assistant foreman passenger cars, foreman passenger cars and foreman enginehouse, powerhouse and machine shop. In 1918 he became associated with the Bureau of Valuation of the Interstate Commerce Commision as junior inspector of car equipment and in October of the following year became senior mechanical engineer engaged in valuing freight, passenger, work, powerhouse and machine shop equipment and locomotives. He resigned on March 1, 1922, to enter the service of the Boston & Maine as assistant engineer in the corporate engineer's office. He became mechanical inspector in October, 1922; in April, 1923, was appointed general inspector of car maintenance, and in June, 1925, was appointed assistant to the mechanical superintendent. Mr. Becherer resigned from the latter position in April, 1926, to enter the service of the Central of New Jersey as superintendent of the car department.

Car Department

W. J. BOURNE, car foreman of the Missouri Pacific at Gundun, Ark., has been appointed general car foreman, with headquarters at Monroe, La.

J. E. ONG, assistant general car foreman of the Chicago & Alton, has been appointed general car foreman, with headquarters at Bloomington, Ill., succeeding H. A. Harris.

O. H. HAGEN, general foreman of the steel car plant of the Chicago, Burlington & Quincy at Galesburg, Ill., has been appointed superintendent of the steel car plant at that point.

E. G. BISHOP, assistant general car foreman of the Illinois Central at East St. Louis, Ill., has been promoted to the position of general car foreman, with headquarters in the same city.

T. M. AKINS, piecework checker, Oklahoma-Southern division, of the Chicago, Rock Island & Pacific at Ft. Worth, Tex., has been promoted to the position of assistant car foreman, with headquarters at Armourdale, Kan.

JOHN CLARK, general foreman, freight car department, of the Central of New Jersey, with headquarters at Ashley, Pa., has been appointed superintendent

John Clark

of the car department, with headquarters at Jersey City, N. J. Mr. Clark was born at Greenfield, Mass., on March 10, 1895. He entered railroad service in 1912 as a car repairman on the Boston & Maine. On April 22, 1916, he was appointed joint foreman, Boston & Maine and New York, New Haven & Hartford, serving in that position until August 1, 1924, when he became district car inspector of the Boston & Maine. On July 1, 1925, he was appointed general foreman of the Boston & Maine at East Deerfield, Mass., and a year later left this road to become general foreman, freight car department, of the Central of New Jersey.

J. M. HOLT has been appointed general car inspector of the Pacific Lines of the Southern Pacific, with headquarters at San Francisco, Cal., a newly created position, the duties of which relate to car shop production and the maintenance of car equipment.

E. S. TAYLOR, car foreman of the Chesapeake & Ohio at Hinton, W. Va., has been promoted to the position of general car inspector of the Huntington and Big Sandy divisions, with headquarters at Huntington, W. Va.

H. A. HARRIS, general car foreman of the Chicago & Alton, with headquarters at Bloomington, Ill., has been appointed acting master car builder, with headquarters in the same city, succeeding P. W. Helwig, on leave of absence.

Master Mechanics and Road Foremen

CHARLES S. YEATON, road foreman of equipment, Oklahoma-Southern division, of the Chicago, Rock Island & Pacific, has retired. Mr. Yeaton was born at Worcester, Mass., in 1862, and moved to Davenport, Iowa, with his parents in 1870. He entered the enginehouse of the Rock Island at that point in 1877 as a machinist's helper. Two years later he became a fireman on the Oskaloosa branch between Washington and Knoxville, and in 1884 was promoted to the position of engineman. He was transferred to the Kansas division in 1901 and in 1904 was appointed general foreman at Caldwell. In 1905 he was appointed road foreman, with headquarters at Shawnee, Okla., and during the war was sent to Fort Worth, Tex., as master mechanic. Following the war he resumed his position as road foreman of equipment and served in that capacity until his retirement.

J. T. SLAVEN, assistant master mechanic of the Southern Pacific, has been promoted to the position of master mechanic, succeeding C. R. Burroughs, retired.

THE JURISDICTION of W. F. Lauer, master mechanic of the Illinois Central at Memphis, Tenn., has been extended to include the Mississippi division.

WILLIAM WALKER, locomotive foreman of the Canadian National, at Saskatoon, Sask., has been appointed division master mechanic, with headquarters at Prince Albert, Sask., succeeding Willian L. Loomis, deceased.

The headquarters of J. E. Stevens, master mechanic of the St. Louis division of the Mobile & Ohio at Murphysboro, Ill., have been changed to the new enginehouse at Tolson Yards, East St. Louis, Ill.

J. THAYER, general foreman of the Denver & Rio Grande Western at Salt Lake City, Utah, has been promoted to the position of master mechanic, with headquarters at Grand Junction, Colo.

F. A. SCHILLING, enginehouse foreman of the Southern Pacific at Bayshore, San Francisco, Cal., has been promoted to the position of assistant master mechanic succeeding J. T. Slaven.

CHARLES R. BURROUGHS, master mechanic of the Coast division of the Southern Pacific, has retired. Mr. Burroughs entered the service of the Southern Pacific in February, 1886, as a machinist at Wadsworth, Nev. In March, 1887, he was transferred to Sacramento, Cal., where he served successively until October, 1895, as machinist, drop pit foreman, night enginehouse foreman and gang boss. In October, 1895, he was promoted to the position of general foreman on the Coast division, later becoming assistant master mechanic and finally master mechanic.

Shops and Enginehouse

WILLIAM IRVINE has been promoted to the position of general foreman of the Denver & Rio Grande Western shops at Salt Lake City, Utah.

B. D. POWELL, enginehouse foreman of the Chesapeake & Ohio, has been appointed general foreman, with headquarters at Ronceverte, W. Va.

MURRAY K. ROBB, locomotive foreman of the Canadian National at Regina, Sask., has been appointed locomotive foreman, with headquarters at Saskatoon, Sask., succeeding William Walker.

ROBERT CAREY, machinist of the Chesapeake & Ohio, has been promoted to the position of enginehouse foreman, with headquarters at Mound street, Columbus, Ohio, succeeding Jacob H. Ottman, deceased.

T. D. SAAR, general enginehouse foreman of the Kansas City Southern at Heavener, Okla., has been appointed chief locomotive inspector for the entire line, succeeding C. Y. Thomas, resigned.

Purchases and Stores

J. WHITE SPRONG, purchasing agent of the Delaware & Hudson, with headquarters at Albany, N. Y., died on January 5.

W. C. BOWER, manager of purchases and stores of the New York Central Lines, has been appointed vice-president in charge of purchases and stores, with headquarters at New York.

E. R. MORGANROTH has been appointed purchasing agent of the Pacific Coast Railroad and the Pacific Coast Railway, with headquarters at Seattle, Wash., succeeding W. E. Nichols, who has retired.

J. L. COWAN, assistant purchasing agent of the Southern Pacific, Texas and Louisiana Lines, with headquarters at Houston, Tex., has been promoted to purchasing agent with headquarters at New Orleans, La., to succeed N. P. Randolph, retired.

THE JURISDICTION of A. C Mann, vice-president in charge of purchases and stores of the Illinois Central, has been extended to include the testing department This department, which is in charge of J. L. Carver, engineer of tests, with headquarters at Burnside Shops, Chicago, was formerly under the jurisdiction of the mechanical department.

CHARLES R. PAINTER, assistant to the vice-president of the New York, New Haven & Hartford, has been appointed purchasing agent, with headquarters at New Haven. Mr. Painter was born in

Charles R. Painter

July, 1887, at Muncy, Pa. He was educated in the high school in that city and Williamsport Commercial College, entering railway service with the Buffalo & Susquehanna at Austin, Pa., in 1905. Three years later he entered the service of the Atchison, Topeka & Sante Fe, where he was employed in various clerical positions in the mechanical department at La Junta, Colo., and Dodge City, Kans. In November, 1917, he became chief clerk to the general storekeeper of the New York, New Haven & Hartford at New Haven, Conn. In May, 1918, he was promoted to the position of chief clerk to the purchasing agent and in June, 1922 became assistant to the general purchasing agent. Three years later he was appointed assistant to the vice-president in charge of purchases and stores.

Obituary

GEORGE C. BUTLER, retired enginehouse foreman at the Bristol shop of the Norfolk & Western, died on December 6. Mr. Butler had been in the employ of the Norfolk & Western since September 25, 1895.

ROBERT E. BANNIN, general foreman of the locomotive department of the Chicago & Eastern Illinois at Danville, Ill., died on November 18 as the result of a heart attack.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

OIL PURIFIERS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., describes in Leaflet No. 20442 the construction and manner of operation of the combination Sharples centifuge and filter-press oil purifier which has recently been placed on the market.

MONARCH LATHES.—The outstanding features of Monarch helical-geared Timkenized lathes and a complete line of turrets, tool rests and tool room accessories for Monarch lathes are described and illustrated in the new catalogue, No. 131, issued by the Monarch Machine Tool Company, Sidney, Ohio. The catalogue contains 44 pages. Line drawings are used to emphasize the points being discussed.

DARDELET SELF-LOCKING SCREW THREAD.—For ease of illustration, the Dardelet Threadlock Corporation, 120 Broadway, New York, describes in its new 18-page pamphlet the Dardelet thread as it is applied to bolts and nuts. The thread has a profile mathematically designed according to precise calculations of the various stresses to which screw threaded fastenings are subjected, and is adapted not only to bolts and nuts, but also to studs, screws, threaded parts of engines and machinery, and special applications.

GROUND THREAD HANDBOOK.—The third edition of the Ground Thread Handbook, catalogue No. 12, issued by John Bath & Co., Inc., 18 Grafton street, Worcester, Mass., contains chapters on the following subjects: Development of modern tapping; service, stock quotations, trials and packing; ground thread taps; square thread taps; ground thread gages and gaging practice; thread rolling dies and Bath indicator chasers, and tapping helps. The last chapters contain tables and reference data, and an index to the Bath products listed in the catalogue.

TRADE STANDARDS.—The Compressed Air Society has just published the fourth edition of Trade Standards, copies of which may be obtained from the secretary, C. H. Rohrbach, 90 West street, New York, at a cost of 50 cents each. The new material in the pamphlet comprises a formula for use in air compressor testing, this being for higher water columns than those previously used; further suggestions in connection with the installation and operation of air compressors; caution against the use of old boilers or tanks as air receivers; suggestions for handling very cold "cooling water" so as to prevent condensation and undue wear on the air cylinders, and an illustration of an air-cleaning device.